







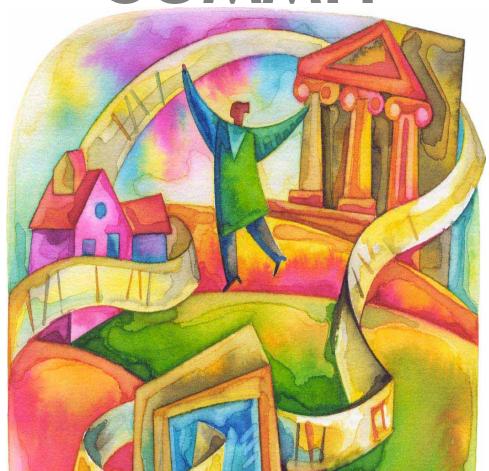






Fort Detrick and National Interagency Confederation for Biological Research (NICBR)

EDUCATION SUMMIT



Thank You for Attending the 2006 Fort Detrick and NICBR Education Summit

November 15, 2006 8:00 a.m.- 4:00 p.m. Lynfield Event Complex 10142 Hansonville Road Frederick, Maryland



November 15, 2006

Dear Education Summit Participant,

Thank you for taking the time to participate in today's Education Summit.

Six federal agencies have embarked on a very exciting initiative at Fort Detrick. We have established the National Interagency Confederation for Biological Research (NICBR) with the goal of working collaboratively to enhance our capacity for research and technology development, with the ultimate goal of delivering new products to protect and improve health. A subset of the NICBR is the National Interagency Biodefense Campus, which focuses on development of medical products and countermeasures to protect the nation from bioterrorism.

Both the confederation and the biodefense campus represent a forward-looking enhancement of our nation's science and technology infrastructure right here in Frederick County. However, as we look ahead to greater scientific capabilities, we know we will need a scientifically literate and proficient work force to fully capitalize on these new resources. Accordingly, each of the partner agencies of the confederation has accepted "building the bench," or educational outreach, as a critically important investment.

Today's adults have witnessed incredible advances in science and technology over the past half century and we know that the pace of technological change is likely to accelerate as our children enter the work force. Each of the leaders attending today's summit would probably cite educational opportunity as the one most important enabling factor in their productive careers. The purpose of today's meeting is to partner with academia and business so as to provide ample educational opportunities for enabling tomorrow's scientists.

On behalf of the National Cancer Institute, the National Institutes of Health, the Department of Homeland Security, the Department of Agriculture, the Centers for Disease Control and Prevention, and the U.S. Army Medical Research and Materiel Command, I welcome you to our Education Summit and, again, thank you for participating.

Eric B. Schoomaker, M.D., Ph.D.

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Major General, U.S. Army Commanding General

Workforce for the Future – The Way Forward

rrorry	November 15, 2006			
7:30-8:00	Registration and Continental Breakfast			
8:00-8:30	Welcome	MG Eric B. Schoomaker U.S. Army Medical Research and Materiel Command Commanding General		
8:30-9:00	Local, State, and National Workforce Development Issues	Dr. Bruce Fuchs Director, Office of Science & Education, NIH		
9:00-10:40	Challenges			
	• K-12	Dr. Linda Burgee Superintendent, FCPS		
	Higher education	Dr. Carol Eaton President, FCC		
	 Mentorship 	Dr. Donna Vogel Ellison Medical Foundation		
	Importance of Program Evaluation	Dr. Debra Yourick WRAIR		
	Question & Answer Period			
10:40-11:00	Break			
11:00-11:20	The Importance of Business Partnerships: Understanding the Issues and Aligning Business and Educators	Dr. R. Daniel Cunningham Deputy Superintendent, FCPS		
11:20-12:00	Outreach Programs			
	 STEM Education and Workforce Development, Office of the Secretary of Defense, ATL 	Mr. Keith Thompson Office of the Secretary of Defense		
	WRAIR/Fort Detrick - GEMS	Dr. Marti Jett/Dr. Beth Leffel		
	Bechtel ACE	Ms. Carrie Arnold-Gutierrez		
	 NCI Elementary Outreach and Werner H. Kirsten Student Internship Programs 	Ms. Barbara Birnman		
	• USDA	Ms. Diana Sherman		
12:00-1:00	Lunch			
1:00-1:50	Keynote Speaker	Dr. Freeman A. Hrabowski, III		
1:50-3:20	Facilitated Group Discussions	President, UMBC Ms. Kathleen Joyce		
3:20-4:00	Report & Closing	COL Mary R. Deutsch & Facilitators		

Biographies In order of appearance



Major General Eric B. Schoomaker Commanding General of the US Army Medical Research and Materiel Command and Fort Detrick

MG Schoomaker was born into an Army family in Detroit, Michigan. In 1970 he graduated from the University of Michigan in Ann Arbor, was commissioned a Second Lieutenant as a Distinguished Military Graduate, and awarded a Bachelor of Science degree. He received his medical degree from the University of Michigan Medical School in 1975 and completed his Ph.D. in Human Genetics in 1979.

He completed his internship and residency in Internal Medicine at Duke University Medical Center in Durham, North Carolina, from

1976 to 1978, followed by a fellowship in Hematology at Duke University Medical Center in 1979. He is certified by the American Board of Internal Medicine in both Internal Medicine and Hematology. His military education includes completion of the Combat Care Casualty Course, Medical Management of Chemical Casualty Care Course, AMEDD Officer Advanced Course, Command and General Staff College, and the US Army War College.

General Schoomaker has held a wide variety of assignments. From 1979 until 1982, he was a research hematologist at Walter Reed Army Institute of Research. He served as Assistant Chief and Program Director, Department of Medicine, Walter Reed Army Medical Center, 1982-1988; Medical Consultant to Headquarters, 7th Medical Command, Heidelberg, Germany, 1988-1990; Deputy Commander for Clinical Services, Landstuhl Army Regional Medical Center, Landstuhl, Germany, 1990-1992; Chief and Program Director, Department of Medicine and Director of Primary Care, Madigan Army Medical Center, Tacoma, WA, 1992-1995; Director of Medical Education for the Office of The Surgeon General/HQ USAMEDCOM conducting a split operation between Washington, DC, and Fort Sam Houston, TX, 1995-1997; and Director of Clinical Operations at the HQ USAMEDCOM, February to July 1997. From July 1997 to July 1999, he commanded the USA MEDDAC (Evans Army Community Hospital) at Fort Carson, CO. He attended the US Army War College in Carlisle Barracks, PA, from 1999 to 2000 followed by assignments as the Command Surgeon for the US Army Forces Command (FORSCOM) from July 2000 to March 2001, and Commander of the 30th Medical Brigade headquartered in Heidelberg, Germany, from April 2001 to June 2002. Prior to his current assignment as Commanding General of the US Army Medical Research and Materiel Command and Fort Detrick, he was Commanding General of the Southeast Regional Medical Command/Dwight David Eisenhower Army Medical Center from June 2002 to June 2005.

In August 2002, The Army Surgeon General appointed General Schoomaker to the position of Chief of the Army Medical Corps.

His awards and decorations include the Distinguished Service Medal, the Legion of Merit with four oak leaf clusters, the Meritorious Service Medal with two oak leaf clusters, the Joint Service Commendation Medal, the Army Commendation Medal, the Army Achievement Medal and the Humanitarian Service Medal. He has been honored with the Order of Military Medical Merit and the "A" Proficiency Designator and holds the Expert Field Medical Badge.

General Schoomaker is married and has three children.



Dr. Bruce A. Fuchs, Director of the National Institutes of Health's (NIH) Office of Science Education (OSE).

Dr. Fuchs is responsible for monitoring a range of science education policy issues and providing advice to NIH leadership. He also directs the creation of a series of K-12 science education curriculum supplements that highlight the medical research findings of the NIH. The NIH Curriculum Supplement Series is designed to meet teacher's educational goals as outlined in the National Science Education Standards and is available free to teachers across the nation. The office also actively creates innovative science and career education Web resources, such as the

LifeWorks career exploration site, accessible to teachers and students across the nation. These resources are available at http://science.education.nih.gov

Dr. Fuchs is serving on the Education and Workforce Development working group of the *National Science and Technology Council* (NSTC) and on working groups of the Department of Education's *Academic Competitiveness Council* (ACC). He was a member of the K-12 education focus group for the National Academy of Science's report *Rising Above the Gathering Storm*. (The *Gathering Storm* report led the President to propose the *American Competitiveness Initiative* during his 2006 State of the Union speech.) In 2005, Dr. Fuchs was requested by the Department of Education to serve as the U.S. representative to the Asian Pacific Economic Cooperation (APEC) meeting on *Best Practices in Math and Science Education*. For a number of years Dr. Fuchs was the NIH representative to the Department of Education's *National Education Research Policy and Priorities Board* (NERPPB) That experience led to his continuing interest in the debate over how to make educational research more effective.

Prior to coming to NIH, Dr. Fuchs—an immunologist who did research on the interaction between the brain and the immune system—was a researcher and teacher on the faculty of the Medical College of Virginia. He had grant support from both the National Institute of Mental Health and the National Institute on Drug Abuse. He has a B.S. in Biology from the University of Illinois and a Ph.D. in Immunology from Indiana State University. He was born and raised in Springfield, Illinois (although not actually in a corn field as he sometimes claims.)



Linda Burgee, Ed.D. Superintendent of Frederick County Public Schools

A Frederick County native, Dr. Burgee began her education career with Frederick County Public Schools (FCPS) in 1976 as an elementary teacher. In the years since, she has advanced through the district's administrative ranks, rising from assistant principal and principal to elementary instructional director and then associate superintendent. In June 2004, Dr. Burgee was appointed Superintendent of FCPS, which today includes leadership of 5,000 employees and the education of more than 40,000 students.

Committed to working with families, community agencies and organizations to support student achievement, Dr. Burgee is involved in a number of community organizations, including the Rotary Club of Frederick and the Committee for Frederick County. In 2005, the Frederick County Commission for Women honored her with the Frederick Woman of Achievement Award.

Dr. Burgee believes that public education serves as the foundation for a community's quality of life and that all children deserve the very best possible opportunity to learn and grow.



Carol W. Eaton, Ph.D. President of Frederick Community College

Dr. Carol W. Eaton assumed her duties as the seventh President of Frederick Community College (FCC) in August of 2005. Prior to joining FCC, she served as the Vice Chancellor for Community Colleges at the State University of New York (SUNY), and as President of Clinton Community College in Plattsburgh, New York. Carol has earned all of her degrees from the State University of New York beginning with an Associate in Applied Science Degree in Data Processing from SUNY Cobleskill. She also has a bachelor's degree in Mathematics, a master's degree in Mathematics Education, and a Ph.D. in Curriculum and Instruction with major emphasis in Mathematics Education from SUNY Albany.

To ensure that FCC is responding to the needs of the Frederick community, Carol gains insight from her involvement in a wide variety of organizations. Her community activities include the Frederick Rotary, Fort Detrick Community Liaison Council, as well as board positions with the Business Development Advisory Council, Frederick Innovative Technology Center, Goodwill Industries of Monocacy Valley, and National Institute for Leadership Development. Along with the presidents of the other 15 community colleges in the state, she is extremely active in the Maryland Association of Community Colleges.



Donna L. Vogel, M.D., Ph.D Deputy Director, Ellison Medical Foundation

Donna Vogel is a graduate of Bryn Mawr College, and of the Medical Scientist Training Program at the Albert Einstein College of Medicine where she received her Ph.D. in developmental biology and her M.D. with a subspecialty in endocrinology.

In 1980 Dr. Vogel joined NIH as a clinical fellow in the National Institute of Child Health and Human Development, conducting clinical and basic research relating to infertility and reproductive medicine. She moved to the extramural program in 1987 to manage the Reproductive Medicine portfolio, and worked as a program director for 13 years in positions of increasing responsibility. These included Training Officer for the Reproductive Sciences Branch,

covering training and career development activities, and minority/disability issues; Associate Branch Chief for Clinical Research, and Acting Deputy Director, Center for Population Research.

For many years, Dr. Vogel has been an advisor to NIH on women's health, in various capacities. In 1999 she worked with the Office of Research on Women's Health to create and manage the innovative career development grant program, "Building Interdisciplinary Research Careers in Women's Health."

From 2001 to 2005, Dr. Vogel worked at the National Cancer Institute. She was the first Director of its Fellowship Office, dedicated to enhancing the professional experience for postdoctoral fellows. She continues to serve on the Advisory Board of the NIH Visiting Fellows Committee, and is especially interested in career development and mentoring.

Dr. Vogel has served on the Executive Council of the American Society of Andrology, and has chaired and served on numerous committees within the government and for professional organizations. She has organized many workshops, published research and administrative papers and book chapters, and has received awards from NICHD, the US Public Health Service, professional societies, and community groups.



Debra L. Yourick, Ph.D. Associate Director for Research, Marketing and Policy Development, WRAIR

Dr. Yourick received her Ph.D. in Pharmacology and Toxicology in 1987 from the University of Kansas. In 1988, She accepted a position working for Dr. James Meyerhoff, Division of Neuropsychiatry, at the Walter Reed Army Institute of Research (WRAIR) in Washington, DC. Her initial work involved studies of acquired epilepsy and head injury. Since 2004, her position at WRAIR has been that of Associate Director for Research, Marketing and Policy Development, where she works with public affairs and news agencies from around the world. She is involved in communicating the Institute's scientific studies in the areas of

combat casualty care, infectious diseases, military operational medicine and chemical and biological defense to the public. She reviews and provides guidance to augment funding of these research endeavors for the Institute's scientists. She continues active research in the area of chemical defense and studies new therapeutic options to protect the brain from chemical weapons such as nerve agents. Other active research areas include neurotoxicity as a consequence of malaria prophylaxis and novel antimalarial drugs.

She is very interested in the education of young people, especially in the sciences, and is the Co-Director of Science Education Programs at WRAIR working with the Department of Defense Science and Engineering Apprentice Program. She and Dr. Marti Jett have created and received National Institutes of Health funding for the Gains in the Education of Mathematics and Science (GEMS) program which was recently recognized as a 'best practice' by the Office of the Assistant Secretary of the Army (Acquisition, Logistics and Technology). The GEMS program is currently being disseminated nationally to other Army research laboratories (including Fort Detrick) throughout the Major Commands (MACOMS). The programs included over 600 students at WRAIR in 2005. Their work with student programs was recently featured in a cover story by the Washington Post Magazine (31 July 2005). She is active in her community and professional societies with respect to outreach in science education through lectures and volunteering.



R. Daniel Cunningham, Jr., Ed.D. Deputy Superintendent, Frederick County Public Schools, Frederick, Maryland

For 32 years, Dr. R. Daniel Cunningham, Jr. has been a leader in education. He began his affiliation with Frederick County in 1983 first serving as an Assistant Principal for middle and high schools. As his career progressed, Dr. Cunningham's leadership roles included working as Principal of a middle and high school, and as Assistant to the Superintendent, Associate Superintendent and currently, he is the Deputy Superintendent. Prior to his work with Frederick County Public Schools, Dr. Cunningham was a teacher, counselor and member of the administration of the Caroline

County Public Schools for almost a decade. Dr. Cunningham has published and presented widely on high school block scheduling, dropout prevention and leadership development. During his career, Dr. Cunningham has been recognized for his commitment to excellence in educating students by the U.S. Department of Education as Principal of a Blue Ribbon School, by The Washington Post as a Distinguished Educational Leader, and by colleagues in the Frederick County Public Schools as Administrator of the Year. Dr. Cunningham's professional affiliations include membership in the National and Maryland Association of Supervision and Curriculum Development, American Association of School Administrators, and in the College Board, where he sits on the Middle States Regional Advisory Board. In addition, he is currently the chair of the

local Chamber of Commerce Education Committee and he is an adjunct professor at Towson University in their graduate educational leadership program. Dr. Cunningham holds B.S. and M.Ed. Degrees from Towson University, Baltimore, Maryland and an Ed.D. from Nova Southeastern University, Fort Lauderdale, FL.



Keith Thompson STEM Education and Workforce Development Office of the Director for Basic Research, DoD

Keith Thompson has been employed by the Department of Defense since 1985 and was on assignment from the Defense Technical Information Center to the Office of the Secretary of Defense from 1992 until 2004. Keith became involved in STEM education issues in 1994 and has represented OSD on numerous interagency workforce and education committees including several subcommittees and working groups of the President's National Science and Technology Council. The Director, Defense Research and Engineering identified the need within his office for full time attention to the task of organizing the DoD STEM outreach efforts and created a position to fulfill that role. Mr.

Thompson was selected for that task in 2004 and now serves as the Manager of DoD's Science, Mathematics and Engineering Education and Workforce Development efforts.

Elizabeth Leffel, Ph.D., M.P.H. Research Toxicologist, USAMRIID

Dr. Leffel received her Bachelor of Science degree in Biochemistry and Nutrition from Virginia Polytechnic Institute and State University, Blacksburg, VA and her Masters in Public Health in Occupational and Environmental Health from The George Washington Univ. in 1996. She received her Ph.D. in Pharmacology and Toxicology from the Medical College of Virginia/Virginia Commonwealth University in 2002. Later that year she came to the U.S. Army Medical Research Institute of Infectious Diseases, Ft. Detrick and joined the Center for Aerobiological Sciences as an Aerobiology Toxicologist; developing in vivo models for studies on aerosolized biological threat agents. In addition to her research, she has had an interest in science education since 1999, at which time she developed courses and laboratory experiments for teaching high school students in the Questers Program. Dr. Leffel expanded this interest to the Botetourt County Young Scholars program, where she organized and taught "hands-on" toxicology classes to elementary school students. Although she found teaching college level and graduate level courses rewarding, her primary interests remain in younger students. This was made evident during the spring/summer of 2006 in which she was an active leader in establishing the first Gains in the Education of Mathematics and Science (GEMS) program in West Frederick Middle School modeled after a similar program at WRAIR.

Marti Jett, Ph.D. Chief, Department of Molecular Pathology, Walter Reed Army Institute of Research

As a research scientist, Dr. Jett's lab has focused on host-pathogen interactions as a means to identify "stage-specific" biomarkers to indicate the progression of illness and utilize stage-appropriate therapeutic approaches.

She has been a strong supporter, since the mid-80's, of the Science and Engineering Apprentice Program (SEAP) in which talented 11-12th grade high school students work in DoD laboratories during the summer. She took over the administration of the program at WRAIR in 1991. It became clear that to infuse diversity into SEAP, it would require reaching out to younger

students. Due to demands of her full-time research responsibilities, the new effort would need a different approach. She noticed that one of her very capable college students was a "natural" in talking and working with the high school students and came up with the idea of the "near-peer" approach, in which young Jr/Sr high school students (in groups of 4-6) would carry out well-designed, exciting experiments in a teaching lab at WRAIR under the guidance of the well-trained college student. These internships were 1-2 weeks in duration and during that time, the college student would have the opportunity to describe college life and what it took to get there, including a strong emphasis on taking the highest level math classes in school. This program "Gains in the Education of Math and Science" (GEMS) showed success by 1997, with the young 8-9th graders, developing science skills. Many chose science majors in college and are now returning to work in our laboratories as young college students.

In 2000, Dr. Jett was awarded a research grant (NIH, National Center for Research Resources) to optimize and characterize the GEMS internship program, and in 2004, Drs. Jett and Yourick were awarded a second grant to design, carry out and characterize the dissemination of GEMS to other sites. Dissemination has been carried out successfully at 3 other DoD research laboratories and the George Washington University for 3 years. During the summer of 2006, dissemination occurred at the Salish-Kootenai College, Pablo, MT (Flathead Indian Reservation) and West Frederick Middle School (Frederick, MD).

Carrie Arnold-Gutierrez Field Engineering Manager for Bechtel Construction Operations

Ms Arnold-Gutierrez has a Bachelor's of Science degree in Civil Engineering from Texas A&M University and over 18 years of experience in the construction industry. She has worked for Bechtel at the Department of Energy Savannah River Site in South Carolina, Houston, TX and is currently working in Bechtel's office in Frederick, Maryland, as the Field Engineering Manager for Bechtel Construction Operations. Throughout her career Carrie has been an advocate for developing the next generations of Bechtel employees. Recognizing the growing gap in students pursuing careers in the engineering and construction professions, she worked with the ACE Mentor Program of America to start a chapter in Frederick to encourage high school students to follow in her footsteps.

Barbara Birnman Public Affairs Specialist Outreach and Special Programs, National Cancer Institute

Ms. Birnman holds a Bachelor of Arts Degree in Business with a minor in Journalism from the University of Maryland University College. She has 30 years of federal service; four years with the National Eye Institute and the remaining 26 years with the National Cancer Institute. Prior to that, she worked in private industry for ten years. In her ten years at the NCI-Frederick, she has helped to develop and administer educational programs and internships for students K-12 and undergraduates She is also involved with community outreach initiatives including but not limited to the NIH Speakers Bureau and Science Fair Judges listserv, conducting facility tours, arranging lectures, presentations, and interviews for the press, student groups, teachers, and other community based groups, and responding to new educational and community based challenges and initiatives by serving on advisory boards and focus groups and other related committees while consistently interacting with representatives from local, state, and national educational and community-based organizations. She is also involved with coordinating special events for employees at the NCI-Frederick and Fort Detrick.

Diana Sherman USDA Biologist, Equal Opportunity/CR Representative

Ms. Diana Sherman is a Biologist working in the Plant Virology Laboratory at the U.S. Department of Agriculture, Foreign Disease Research Unit at Fort Detrick. Since 2004, she has also served as the Unit's Equal Opportunity/Civil Rights representative focusing her efforts on improving the educational opportunities for local and minority students. She has been active in instituting a formal summer internship program, as well as recruiting more heavily within Maryland for students. Diana has also worked toward diversifying the recruitment process for administrative and technical staffing. Diana received a BS in Biochemistry from Virginia Polytechnic Institute and State University in 1999. Prior to joining USDA-ARS-FDWSRU, she worked for the Biological Defense Research Directorate (Naval Medical Research Center) as a molecular biology technician for 2 years. She is an active member of the North Atlantic Area EO/CR Committee, the Fort Detrick Special Emphasis Program Committee and the Education and Training Working Group of the Scientific Interactions Subcommittee.



Freeman A. Hrabowski, Ph.D. President, The University of Maryland, Baltimore County

Dr. Hrabowski has served as President of UMBC (The University of Maryland, Baltimore County) since May, 1992. His research and publications focus on science and math education, with special emphasis on minority participation and performance. He serves as a consultant to the National Science Foundation, the National Institutes of Health, and universities and school systems nationally. He also sits on several corporate and civic boards. Examples include the Carnegie Foundation for the Advancement of Teaching, Constellation Energy Group, the France-Merrick Foundation, Marguerite Casey Foundation (Chair), McCormick & Company, Inc., Mercantile Safe Deposit & Trust Company, and the Urban Institute.

Examples of recent awards or honors include election to the American Academy of Arts & Sciences and the American Philosophical Society; receiving the prestigious *McGraw Prize in Education*, the U.S. *Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring*, and the Columbia University *Teachers College Medal for Distinguished Service*; being named a Fellow of the American Association for the Advancement of Science and *Marylander of the Year* by the editors of the *Baltimore Sun*; and being listed among *Fast Company* magazine's first "Fast 50 Champions of Innovation" in business and technology. He also holds a number of honorary degrees, including most recently from Princeton University, Duke University, the University of Illinois, the University of Alabama-Birmingham, Gallaudet University, Goucher College, the Medical University of South Carolina, and Binghamton University.

He has co-authored two books, *Beating the Odds* and *Overcoming the Odds* (Oxford University Press), focusing on parenting and high-achieving African American males and females in science. Both books are used by universities, school systems, and community groups around the country.

A child-leader in the Civil Rights Movement, Dr. Hrabowski was prominently featured in Spike Lee's 1997 documentary, *Four Little Girls*, on the racially motivated bombing in 1963 of Birmingham's Sixteenth Street Baptist Church.

Born in 1950 in Birmingham, Alabama, Dr. Hrabowski graduated at 19 from Hampton Institute with highest honors in mathematics. At the University of Illinois at Urbana-Champaign, he received his M.A. (mathematics) and four years later his Ph.D. (higher education administration/statistics) at age 24.

Musicians

Elise Alley (Violin) is a freshman in the Shenandoah University Conservatory where she majors in Music Education. She began violin lessons nine years ago under Ms. Phyllis Freeman, Mrs. Lisa Sadowski and is currently a student of Dr. Mark Ramirez at Shenandoah. Elise was a member of Frederick Regional Youth Orchestra for seven years, concert mistress of the Senior Orchestra for FRYO during those last three years and has been a three-time soloist in the annual FRYO Concerto Concerts. Elise has participated in chamber groups through the youth orchestra, at her high school and under her private instructors, and for three years, played frequently during Mass at the Visitation Monastery. In addition, during the 2005-06 season, Elise was a full member of the Frederick Symphony Orchestra. Currently, she is a member of the Shenandoah University Conservatory Orchestra, under the direction of Dr. Jan Wagner.

Cameron Grimes (Cello) is a home-schooled junior. He has been playing cello for ten years and is currently under the instruction of Dr. Bazala-Kim. In addition to solo cello performances, Cameron has played in several orchestras and ensemble groups, including the Potomac Valley Youth Orchestra, the Peabody Preparatory Orchestra, and he currently sits principal cellist for the Academy of Saint Cecilia's Youth Orchestra. In addition, he is the cellist in the Emmanuel String Quartet.

Elisha Summers (Violin) a fifteen year old home-schooled student, began violin lessons in 1999 at the age of eight years. His instructor, Rachel Cooper, a fellow home-schooled student, was fourteen at the time and they continued their student-teacher relationship until Rachel entered Julliard in 2004. Since then, Elisha has studied with Mrs. Lisa Sadowski of Peabody Institute. Elisha enjoys playing in a violin quartet and using his ability to minister in music in Walkersville Christian Family Schools, his church and in nursing homes.

Thank You

STEM Education Project Office

Steve Priselac

The Education and Training Working Group and Education Summit Planning Committee

Bob Anderson – DCTEE

Dr. Kevin Anderson – DHS

Terri Baker – DCTEE

Dr. Debby Berlyne – SAIC

Barbara Birnman – NCI-Frederick

Dr. John Carra – USAMRIID

Dr. Nancy Decker - NIAID

Dr. John Ezzell – DCTEE

Dr. Alan Feister - SAIC

Vincent Fiammetta – DCTEE

Carol Garrand - DCSP

Julie Hartman – NCI – Frederick

Kathleen Joyce – SAIC

Dr. Beth Leffel – USAMRIID

Dr. Doug Luster – USDA

Remat Mughal – SAIC

Edward Nolan – USAG

Diana Sherman – USDA

Maria Teran-Maciver - CDC

Beverly Tuggle – USAG

Bob Watson – SAIC

Frederick County Public Schools

Phillip Brohawn – FCPS

Tim Dean – FCPS

Phyllis Younkins – FCPS

MWR-Food Service & Publicity

Terry Baker Amy Leon

Moderator

Darlene Carver – President, Frederick County Workforce Investment Board

Facilitators

Terri Baker – DCTEE

Robin Brawner – FCPS

Vivian Cade – FCPS

Linda Civetti – FCPS

Kathleen Joyce - SAIC

Danette McCurdy - FCPS

Jason Rubeling – FCPS

Terry Schaeffer – FCPS

Maria Whittemore – FCPS

Dottie Wood – FCPS

Phyllis Younkins – FCPS

Notetakers - SAIC

Dr. Debby Berlyne

Dr. Adam Book

Beth Mathews-Bradshaw

Remat Mughal

Adenyika Smith

Dr. Joshua Wolfe

National Science Center Mobile Discovery Van

Ollie Washington – Deputy Director,

Educational Programs Department

Wayman Stewart – Program Manager,

Mobile Discovery Centers

Richard Cadwell

SFC Nowell Devila

Youth Musicians

Elise Alley – Violin

Elisha Summers – Violin

Cameron Grimes – Cellist















Fort Detrick and National Interagency Confederation for Biological Research (NICBR)

NIH Office of Science Education

Bruce A. Fuchs, Ph.D. Director



Workforce of the Future: The Way Forward

Bruce A. Fuchs, Ph.D., Director NIH Office of Science Education

bruce.fuchs@nih.gov

http://science.education.nih.gov



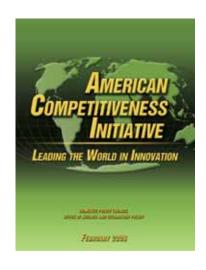








- "And to keep America competitive, one commitment is necessary above all: We must continue to lead the world in human talent and creativity. Our greatest advantage in the world has always been our educated, hardworking, ambitious people -- and we're going to keep that edge. Tonight I announce an American Competitiveness Initiative, to encourage innovation throughout our economy, and to give our nation's children a firm grounding in math and science."
 - President George W. Bush,
 State of the Union Address
 January 31, 2006





Role of the Business Community

Keeping America Competitive



Building a Nation of Learners



 The Knowledge Economy: Is the US Losing its Competitive Edge? THE TASK FORCE
ON THE FUTURE OF AMERICAN INNOVATION
Proceeding in America's Handles

THE KNOWLEDGE ECONOMY: IS THE UNITED STATES LOSING ITS COMPETITIVE EDGE?

> nchmarks of our Innovation Puture February 16, 2005

Tapping America's Potential



Programme for International Student Assessment (PISA)



- http://www.pisa.oecd.org
- Organization for Economic Cooperation and Development (OECD)
- Policy oriented-determined by needs of governments
- "Literacy"- capacity of 15 year old students to apply knowledge
- Not limited to curricular competencies- lifelong learning
- 49 countries- OECD members + others

PISA 2003 Problem Solving



- "OECD countries attach great importance to...an overall capability to solve problems in real-life situations..."
- Three types of problems
 - Decision making
 - System analysis and design
 - Trouble shooting
- Three levels of performance
 - Basic problem solvers
 - Reasoning, decision-making problem solvers
 - Reflective, communicative problem solvers

Problem Solving Example



Figure 1. Map of roads between towns

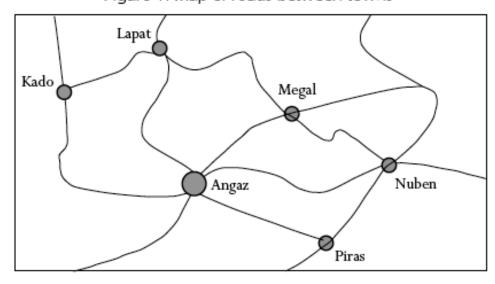


Figure 2. Shortest road distance of towns from each other in kilometres.

Angaz						
Kado	550					
Lapat	500	300				
Megal	300	850	550			_
Nuben	500		1000	450		
Piras	300	850	800	600	250	
	Angaz	Kado	Lapat	Megal	Nuben	Piras

HOLIDAY - Question 1

Calculate the shortest distance by road between Nuben and Kado.

Distance: kilometres.

HOLIDAY - Question 2

Zoe lives in Angaz. She wants to visit Kado and Lapat. She can only travel **up** to 300 kilometres in any one day, but can break her journey by camping overnight anywhere between towns.

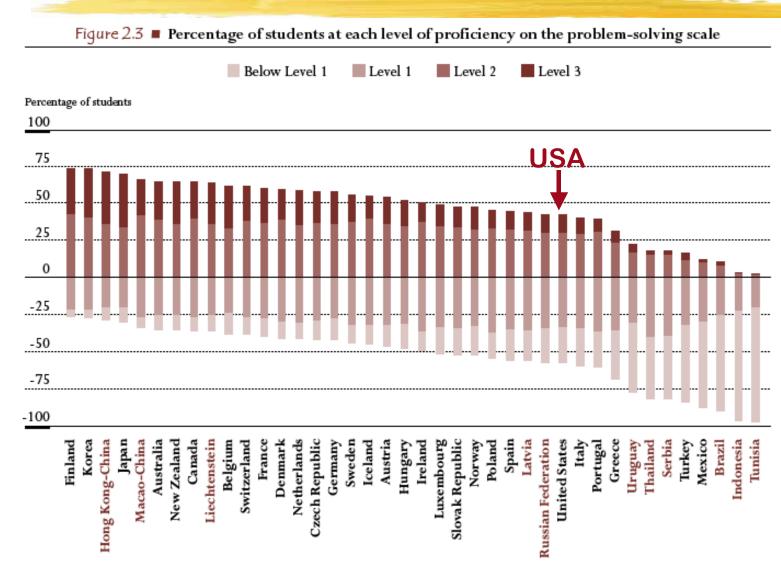
Zoe will stay for two nights in each town, so that she can spend one whole day sightseeing in each town.

Show Zoe's itinerary by completing the following table to indicate where she stays each night.

Day	Overnight Stay
1	Camp-site between Angaz and Kado.
2	
3	
4	
5	
6	
7	Angaz



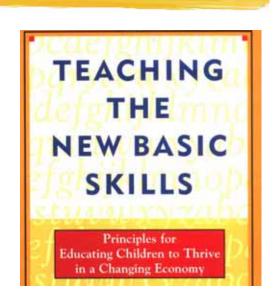
PISA 2003 Problem Solving







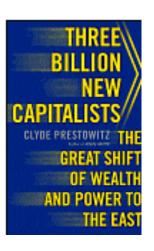
- Richard J. Murnane and Frank Levy
- Skills need for a Middle Class Job
 - Read at a 9th grade level
 - Math at a 9th grade level
 - Solve problems where hypotheses required
 - Ability to work in groups with diverse people
 - Ability to communicate effectively, both orally and in writing
 - Ability to use personal computers for basic tasks
- 50% (or more) of students will not get these skills

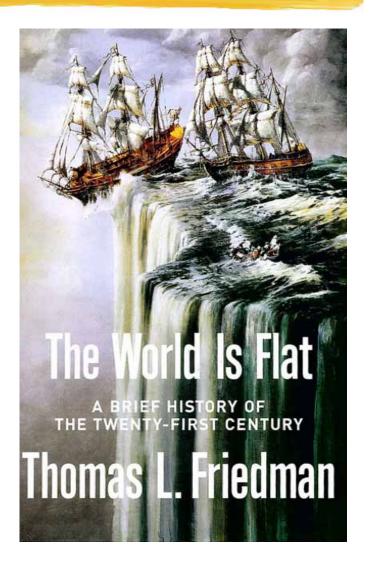


The World Is Flat



- A convergence of events & technologies has allowed economic competition to become global
- An education "surplus" in one part of the world can now satisfy education "deficits" elsewhere
- "We must move up the value chain"
- Education is the key





What Will It Take?



Leadership

- Business community, Education community
- Reform community (NSF, NAS, DOEd, DOD, NSTA, etc.)
- Political

A National sense of purpose

- "A new moon shot"
- Parents, teachers, students, and citizens prepared for challenge and sacrifice

Crisis– another Sputnik?

- Loss of leadership in a major area-- medical tourism?
- Alternative energies from ??

Paradigm & Paradigm Shift



Ptolemaic cosmology to Copernican cosmology

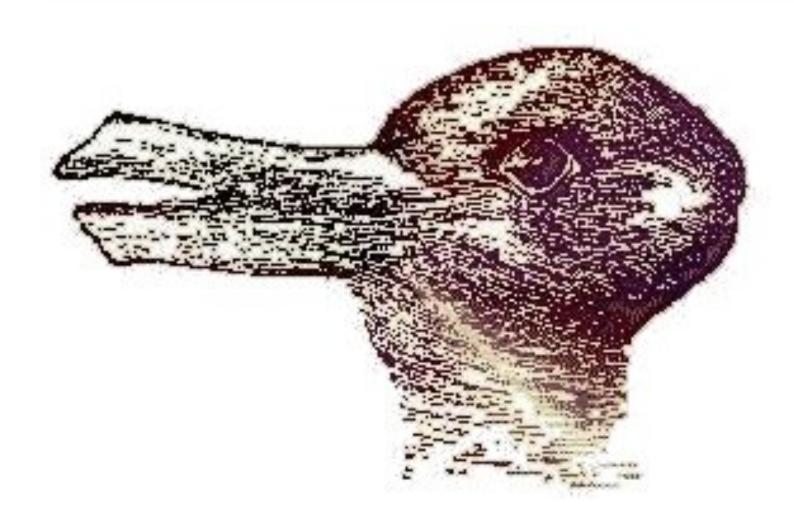
Humoral basis of disease to Germ theory

Newtonian physics to Einsteinian relativity



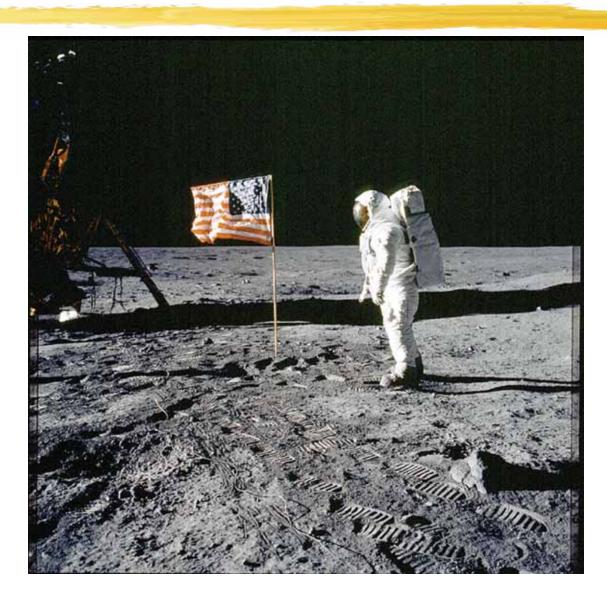


Paradigm & Paradigm Shift



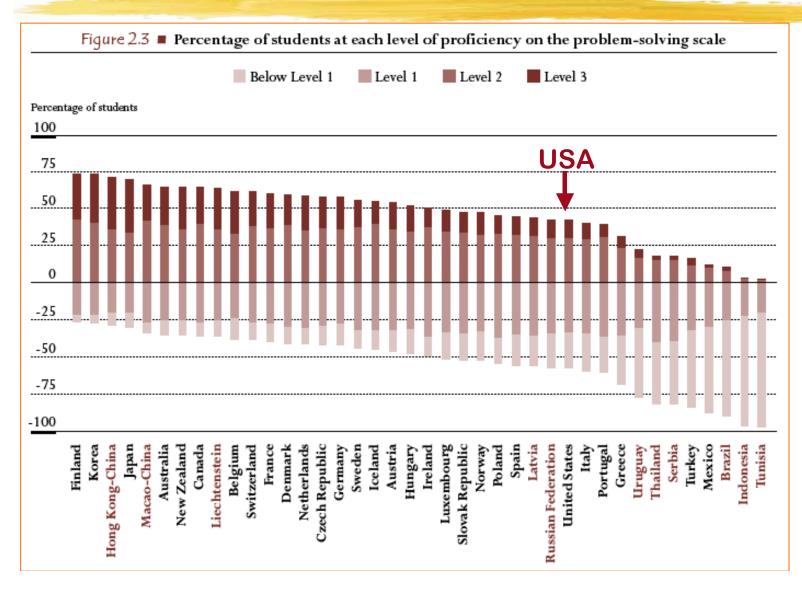


What is the Dominant Paradigm?



New Paradigm









- Truly national science and math standards?
 - Much more rigorous standards (NAEP v. states)
- Differential pay for science & math teachers?





USA has many advantages

- University system
- Business climate- banks, court system
- Transparent securities system
- Strong intellectual property system

China has many challenges

- Can they manage through a recession or a bubble economy?
- Can they establish working courts & I.P. protection?
- Maintain social stability?
- Develop truly world-class universities?

Workforce of the Future: The Way Forward

Bruce A. Fuchs, Ph.D., Director NIH Office of Science Education

bruce.fuchs@nih.gov

http://science.education.nih.gov



























Fort Detrick and National Interagency Confederation for Biological Research (NICBR)

Frederick County Public Schools

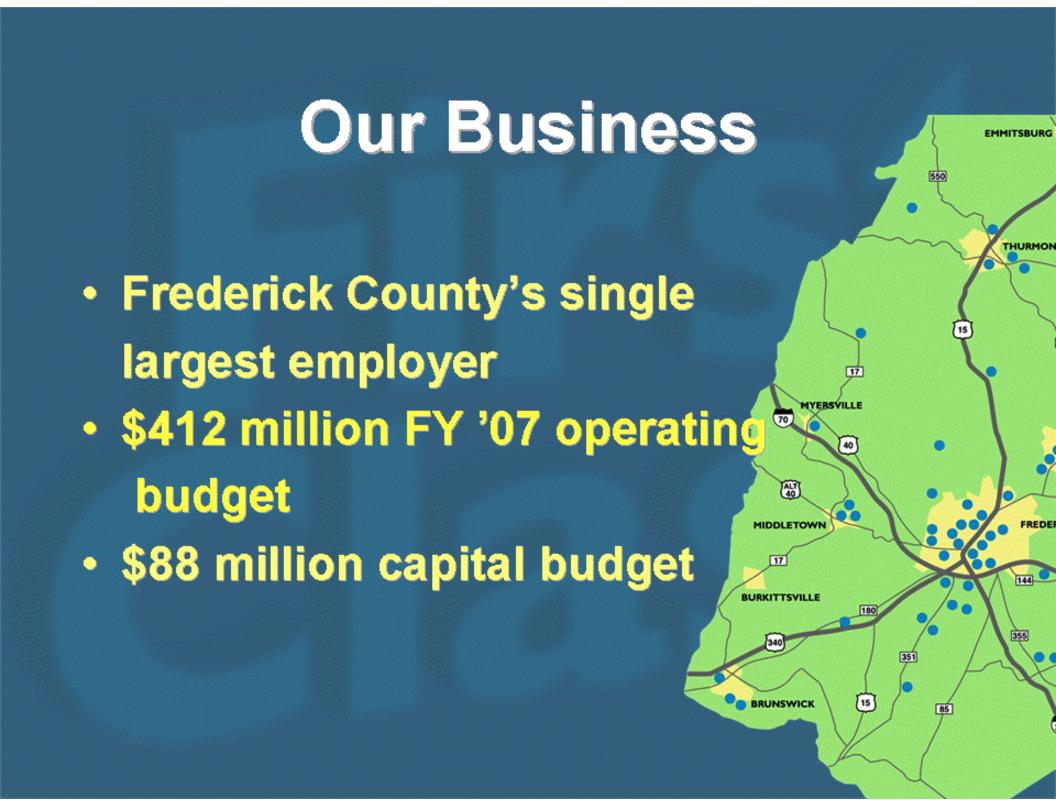
Dr. Linda Burgee Superintendent





Public Education Works in Frederick County

Education Summit 11/15/06



Our stats in the state Of 24 school districts:

- 8th largest
- 5th fastest growing
- Per student:
 - >11h wealthiest district
 - >16th in spending
 - > 2nd lowest in administrative costs

MSDE 2004-05 Fact Book



Our Mission

To establish a learning environment that capitalizes on all children's natural curiosity, nurtures their desire to learn, and respects their individual learning styles

First In Maryland: Highest Graduation Rate Lowest Dropout Rate





FCPS students score above the national and state average on standardized measures including SAT and Advanced Placement



- \$33 million in scholarship offers
- Ranked among nation's top 16% for preparing students for work force

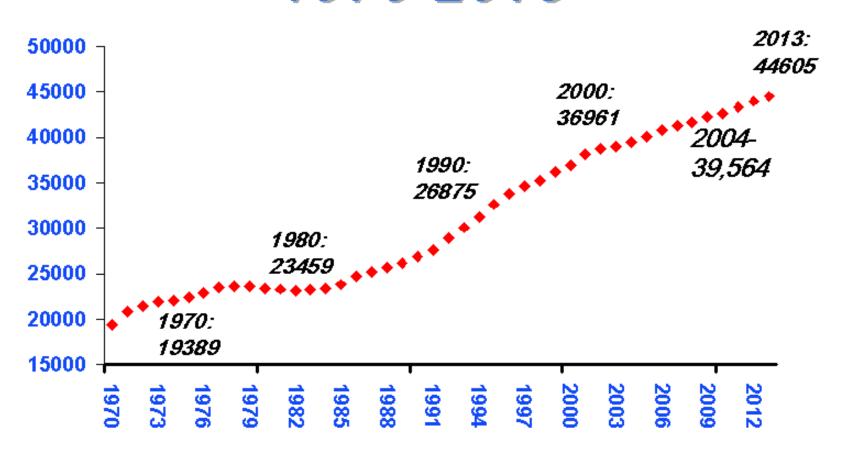
First Class

- 8,400 volunteers
- Strong PTA partnership
- 150 business and agency partners
- 500+ work-study experiences
- 270 + internships
- 700 service learning participants

40,300 Students and Their Families Increasingly diverse and complex

- 79.1% White
- 10.8% African American
- 5.9% Hispanic
- 3.8% Asian/Pacific Islander
- 0.4% Alaskan Native
- Diverse family configurations

FCPS: Total Enrollments 1970-2013



No two students arrive at school equally ready to learn

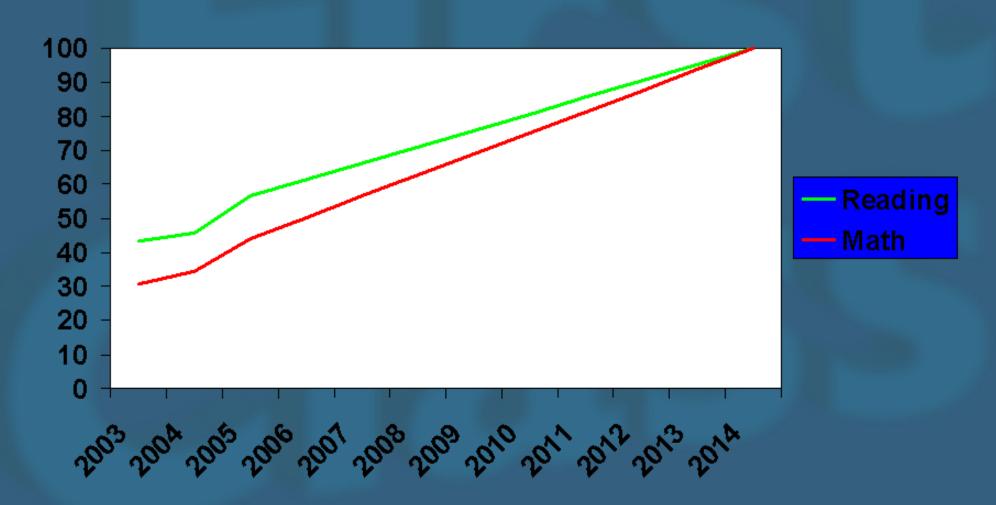
- 15% qualify for free or reduced-price meals
- 12% receive special education services
- 2% are "English Language Learners"



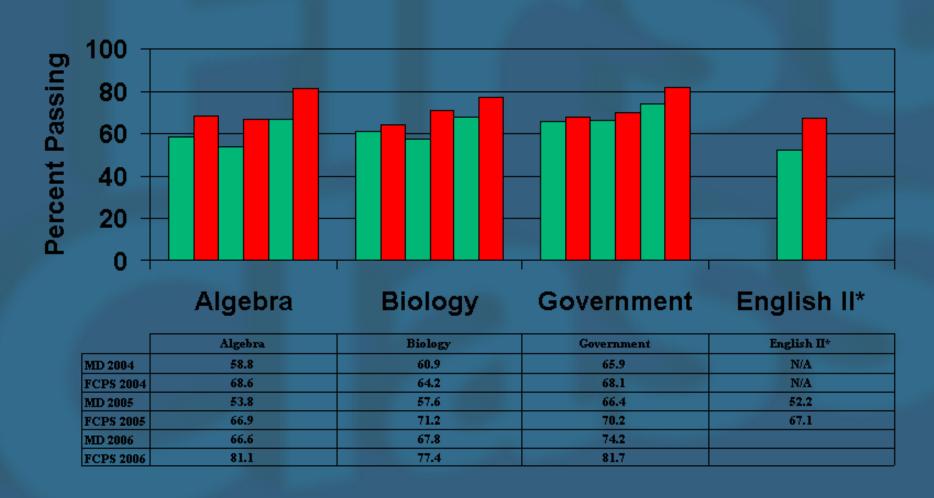
No Child Left Behind A Federal Mandate

- Goal: Eliminate achievement gaps
- High expectations for individual students, subgroups, schools
 - > All students + 8 student subgroups
 - > 20 measures
- "Adequate Yearly Progress" targets rise every year

Annual Measurable Objectives to Meet AYP

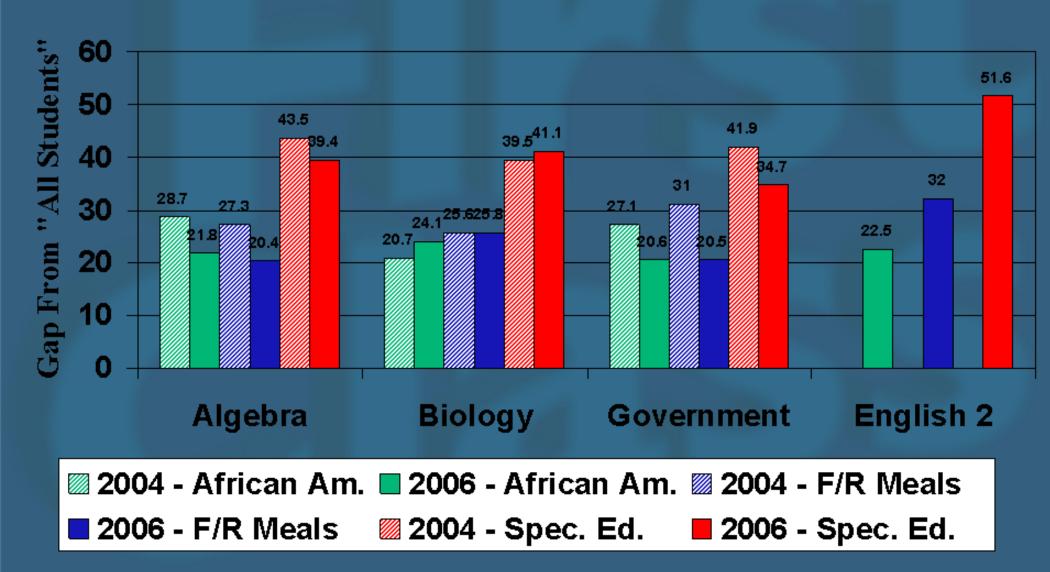


HSA Trends Maryland/FCPS Comparison



* Spring Semester only for 2005

FCPS Achievement Gaps HSA



Colleges Set the Bar Higher



University of Maryland Class of 2009

Applicants:

- 3.70 average GPA
- 1120-1330 SAT*

Admitted:

- 3.93 average GPA
- 1240-1380 SAT*

*middle 50%



Challenges

Meeting the needs of a growing and increasingly diverse student body

 Eliminating achievement gaps while assuring rigor and relevance for the 21st century

Today's Students By Age 21

- 10,000 hours of videos
- 250,000 emails, IM
- 20,000 hours of TV
- 500,000 commercials
- 28,000 hours in school
- 4,000 hours reading books

Challenges

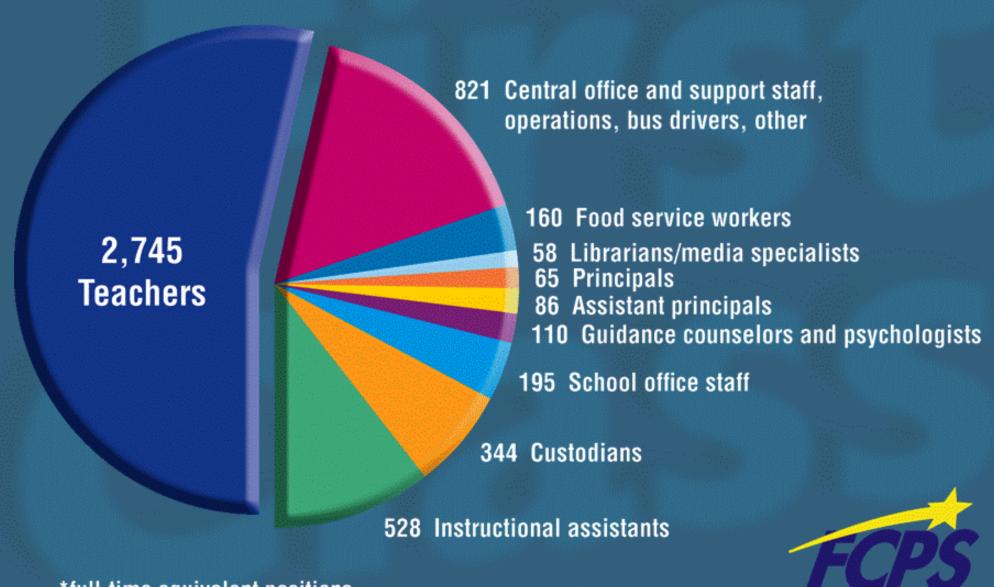
Meeting accountability measures without sacrificing other important goals

- Competing demands for resources
- Mandates that create the "plate is full" syndrome
- Addressing societal issues: social, emotional, health and safety

Our Human Resources



5,112 Employees*



*full-time equivalent positions



Teachers

- 72% hold at least a Masters' equivalency
- 72% have 6+ years of classroom experience



Teacher Salary Standing in Maryland

- 20th for beginning teachers
- 13th for Masters

Goal: Top quarter in the state

Preliminary MSDE 2006-07 data



Challenges

Recruiting and retaining a high quality workforce:

- Math and science
- Foreign language
- Special education
- Increasing meaningful involvement of families and community

Our Capital Assets



Among the County's Largest Property Owners

- 63 schools
- 7 administrative buildings
- 5 million sq. ft. under roof
- 1,500 acres of property



Modernizations: A Priority

- 26 buildings in whole or part are 30+ years old
- Top of the list at each level:
 - Linganore HS
 - West Frederick MS
 - Lincoln ES



Challenge

Securing adequate resources to address the need for new seats as well as the need for renovations



















Fort Detrick and National Interagency Confederation for Biological Research (NICBR)

Frederick Community College

Dr. Carol Eaton President



Workforce for the Future – The Way Forward

Fort Detrick/NICBR Education Summit November 15, 2006

Dr. Carol Eaton, President



The demographic information in this presentation was developed by CSD People Architects





Growth of the U.S.

- U.S. unique
 - Only developed country that is growing
 - 32% by 2050
- Europe will lose 10% by mid-century
- Eastern Europe lost 3.4 million people 2000 to 2005
- Very low fertility in developed countries
- Very high fertility in Africa and Middle East



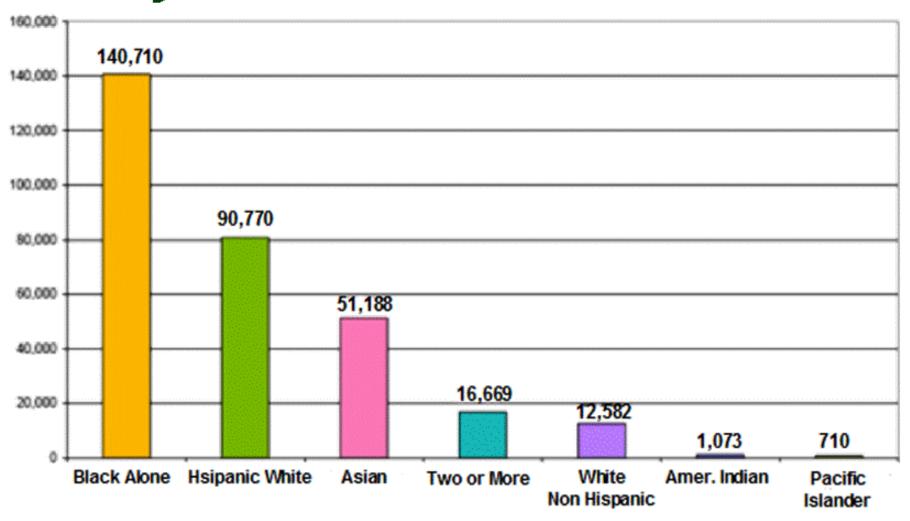
Maryland and Frederick Co. Population 2005 – 2025

- Maryland Increase
- 2005-2010 298,375
- 2010-2015 219,650
- 2015-2020 199,750
- 2020-2025 185,675

- Frederick Increase
- 2005-2010 21,350
- 2010-2015 22,400
- 2015-2020 22,300
- 2020-2025 22,500



Maryland Growth - 2000 to 2005





Frederick County Migration 1995 - 2000

<u>In-migration</u>

- Montgomery 11,165
- Prince George 1,994
- Carroll 1,627
- Washington Co 1,402
- Howard Co 1,302

Out-migration

- Montgomery 3,248
- Washington Co 3,118
- Carroll Co 1,275
- Jefferson, WV 1,044
- Prince Georges 847



Where Frederick Residents Work

 Frederick County 	59%
 Montgomery County 	22%
 Washington D.C. 	3%
 Washington Co., MD 	2%
 Carroll County 	2%
 Fairfax Co., VA 	2%
 Howard County 	2%



Spellings Report – Six Major Challenges

- Need to expand access
- Enhance affordability
- Cut costs
- Restructure existing financial aid programs
- Raise the quality of teaching and learning
- Increase accountability



Educational Attainment Maryland and Frederick County 2005

Population 25 years and over	MD	Frederick
Less than 9th grade	4.3%	3.3%
9th to 12th grade, no diploma	8.7%	6.6%
High school graduate (includes equivalency)	26.7%	28.2%
Some college, no degree	19.6%	20.4%
Associate's degree	6.3%	7.8%
Bachelor's degree	19.3%	21.9%
Graduate or professional degree	15.2%	11.8%



Job Training and Education

- Frederick County residents' jobs are urban and suburban – Agrarian jobs greatly diminished
- 41% of jobs are outside the County
- Residents compete in regional job market, not just local
- Job training/education required to be tailored to compete in this broader market



Frederick – Highest Number of Job Openings 2012

<u>Total</u>	<u>50,175</u>
Cashiers	2,180
Retail Salespersons	1,930
Waiters	1,555
Janitors	1,525
General Managers	1,180



Frederick Highest Number of Job Openings Associate Degree 2012

Registered Nurses	595
Automotive Techs.	180
Fitness Trainers	135
Computer Support	135
Licensed Practical Nurses	115



Frederick Highest Number of Job Openings Bachelor's Degree 2012

General Managers	790
Systems Managers	300
Financial Advisors	255
Software Engineers	215
Construction Mgr.	185



Teacher Education

Helping students learn to BE, not just learn to know



Recommendations

- Develop incentives for business and industry to partner with education
- Double the number of engineering, mathematics, computer, and science majors in Frederick County by 2012
- Focus on transferability of courses from two-year to four-year programs
- Consider a bioscience higher education center in Frederick County

















Fort Detrick and National Interagency Confederation for Biological Research (NICBR)

Ellison Medical Foundation

Dr. Donna L. Vogel



S&I

The Mentoring Mindset Donna L. Vogel, M.D., Ph.D.

reprinted from S&T A quarterly newsletter on research, teaching, management, policy-making and leadership in Science and Technology April 2002

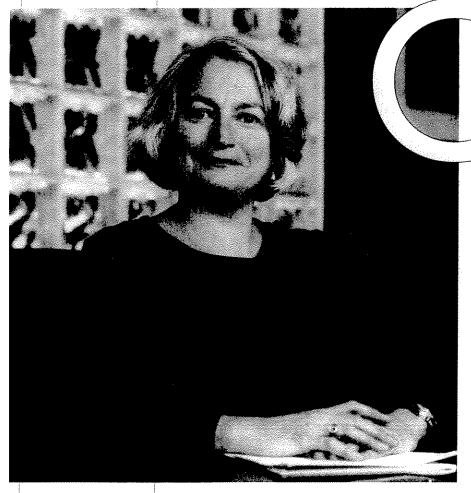
BRYN MAWR COLLEGE Public Affairs Office Benham Gateway 101 North Merion Avenue Bryn Mawr, PA 19010-2899

Commentary

The Mentoring Mindset

By Donna L. Vogel '71

Donna L. Vogel '71



NE DAY LAST YEAR, I was meeting with a delegation from a foreign research agency. They had recently achieved their goal of funding a target number of postdoctoral fellowships, but were just beginning to face the issues of quality in research training. English was not their first language, and one of them asked me "What is the difference between a sponsor and a mentor?" Needing to give a concise and instantly comprehensible answer, I replied, "A mentor provides the trainee every opportunity to develop into an independent scientist."

In my first year at the helm of a new office dedicated to fellows at the National Cancer Institute, I have been devoting a lot of thought to those opportunities: what the gaps are, how to raise awareness and how to fill the needs.

Culture Change Needed

In conversations with postdocs as well as investigators, I am learning that there is a wide spectrum of mentoring attitudes and styles. Many sponsors clearly recognize and act upon their responsibility to grow the next generation of scientists. Some, however, still view trainees largely as a source of labor. And yet others believe that if postdocs are capable, they can make it on their own without any coddling.

The unfortunate result of these latter views is that many talented young people do not meet their full potential — and their ability is lost to science and society. To avoid this outcome, cultural change is needed to make the mentoring mentality part of every supervisor's mindset. Virtually all research supervisors understand their obligation to impart facts and techniques; our task is to help supervisors understand it is also their obligation to teach and provide the tools that trainees need to thrive in science careers.

Mentor-Trainee Dyad

The primary focus of a mentor-trainee dyad is the project itself. The mentor has the breadth of experience to suggest a project and offer judgment as to the project's importance and feasibility. The trainee's responsibility is to carry out the work to her or his best ability, and in accord with ethical and legal standards. With time, the trainee gains ownership of the work, progressing to independence. Ideally, the mentor-trainee relationship grows into one of collegiality, not competition.

Beyond the project itself, I see the expectations between trainees and mentors falling into four categories: visibility, communication, employability and evaluation. Although they overlap to some degree, each category can be framed as an area in which the mentor provides opportunities, constructive criticism and encouragement; and the trainee has the responsibility to seek out and take advantage of those opportunities.

Four Categories of Expectations

Visibility is frequently undervalued by both trainees and mentors, and it is most easily accomplished stepwise, beginning in lab meetings or retreats. Progressing from these generally nonthreatening settings and surrounded by familiar faces, the trainee should begin to submit abstracts to regional and national meetings and request oral presentation when it suits the material. There is no substitute for an audience of one's peers, mentors and potential employers, and professional society meetings are opportunities not to be squandered. These venues also can open doors to collaboration with colleagues who would otherwise be unaware of the work being presented.

The mentor should be aware of opportunities for the trainee to win awards and should support applications from or on behalf of students and fellows. When a site visit is pending from a funding agency, for example, the trainee should be brought into the process of preparation and participation, when appropriate. As the project goes forward, the trainee's growing role will yield increasing recognition, from being acknowledged in the mentor's talk to co-authorship and, eventually, first authorship.

Communication takes many forms. Training in oral presentation skills is recommended, and it can start early with presentations to the trainee's immediate group. The ability to create effective slides and posters cannot be taken for granted any more than the ability to give a talk, and visual communication should also be addressed by the mentor-trainee dyad. Writing for publication, teaching and reviewing manuscripts all provide practice in communication and in acquiring the skills needed for an academic career.

In many careers, the trainee also needs to learn how to apply for grants and the whole grant "culture" beyond simply sending in an application. If the mentor lacks experience, a colleague who has had success in funding should join in the mentoring process.

Employability covers some of the same territory as visibility and communication, but with a specific focus on the job market. When they come into their learning settings, trainees are relatively naive about career options and pathways. They need to find out what the possibilities are, whether through their own advisers, collaborators, student or fellow associations, and professional societies. While an adviser can and should provide introductions and networking opportunities, the trainee must follow up. Other tools for career building include résumé writing, job searching and interviewing, and supervision and management skills.

Evaluation is essential for closing the loop. There is little point to setting expectations without monitoring how well the players are meeting them. Unfortunately, "evaluation" has an image problem: too many of us dread that annual performance review, but the fact is that we cannot get awards, promotions or other types of recognition without documentation of our accomplishments. In addition to regular formal assessment, trainees need and deserve frequent and open informal feedback. An insightful mentor can prevent problems and deal with those that do develop before they reach the point of doing damage.

Finally, mentoring ability — and ultimately mentoring success — should be part of the evaluation of the adviser. This will require a broader view of how we measure "productivity," but I believe we are moving in that direction and research training will be the better for it.

Donna L. Vogel, director of the Fellowship Office at the National Cancer Institute, works to enhance postdoctoral training experiences in basic, clinical and epidemiological research at NCI. The Fellowship Office provides outreach to recruit new fellows, and supports current fellows with information services, research resources, referrais, career counseling and grant entire.

A chemistry major at Bryn Mawr, Vogel earned an M.D. and Ph.D. in developmental biology at the Albert Einstein College of Medicine, Bronx, N.Y. She has conducted and administered clinical and basic research on infertility and reproductive medicine at the National Institute of Child Health and Human Development. Vogel has been active for many years in women's health research.















Fort Detrick and National Interagency Confederation for Biological Research (NICBR)

Walter Reed Army Institute of Research

Dr. Debra Yourick

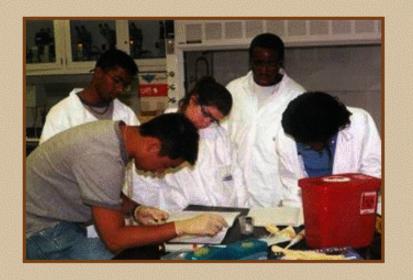




USAMRMC - Building the Bench

The Importance of Program Evaluation

Dr. Debra Yourick and Dr. Marti Jett Walter Reed Army Institute of Research







Facing Unique Challenges

Future Shortage of U.S. Scientists and Engineers Will Limit Our Technological Future

- Local Too few new science Ph.D.s holding U.S. citizenship – required by USAMRMC for security clearance and work in BSL 3-4 laboratories.
- Global The World is Flat (Thomas L. Friedman) Economic competition is global and U.S. deficits will be "filled" by surpluses elsewhere in the world. The U.S. will be part of fewer future global solutions.





Local Initiatives to Train the Next Generation of Scientists

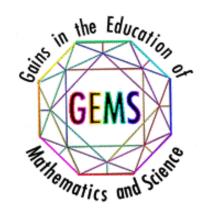
Focus On All Levels of Education

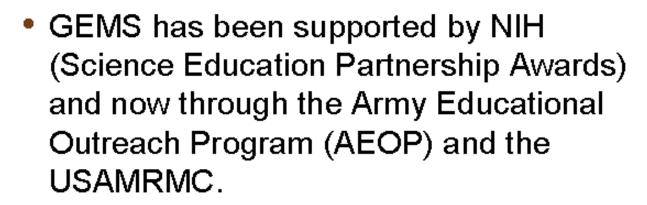
- Gains in the Education of Mathematics and Science (GEMS) at WRAIR and USAMRIID (3 other sites in MD, AL, MT)
- Science and Engineering Apprentice Program (SEAP) at WRAIR and USAMRICD (National Program)
- College Qualified Leaders (CQL only WRAIR)
- Post-doctoral Fellowships at all USAMRMC Laboratories





Funding the Critical Educational Programs







 SEAP administration is funded through the AEOP with management by the USAMRMC (George Washington University holds contract). Stipends are paid by mentors!

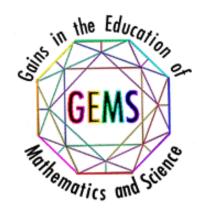


 CQL is supported entirely by individual laboratories utilizing their own RDTE funds.





Impact of Educational Programs







- GEMS is a program methodology to reach as many of the youngest students as possible -most enthusiastic, generally underrepresented in the sciences and attending the most under-privileged schools (likely to expand the science/engineering workforce).
- SEAP is an excellence internship program –
 a place for highly successful GEMS to go
 (uncommon) but mostly local, highly talented
 student participants. "Serves the served" not
 the underserved and unlikely to expand the
 pool of scientists and engineers status quo
 (many such programs nationwide).
 Exceptions
- CQL College level program where many GEMS and SEAP continue. Program is especially beneficial to the laboratory scientist.





History of Programs

- SEAP is 26 years old (1980, Executive Director, Dr. Marylin Krupsaw at GWU, Jett/Yourick direction at WRAIR since 1991/92) – program evaluation has been retrospective and incomplete.
- SEAP CQL is 13 years old; program evaluation began with STARS/GEMS evaluations.
- STARS/GEMS is 12 years old (1995, developed by Jett/Yourick, funded by NIH/NCRR in 2000) – rudimentary evaluation from the earliest programs (formative assessments, early surveys, inclusion of hierarchical research staff to evaluate and participate).





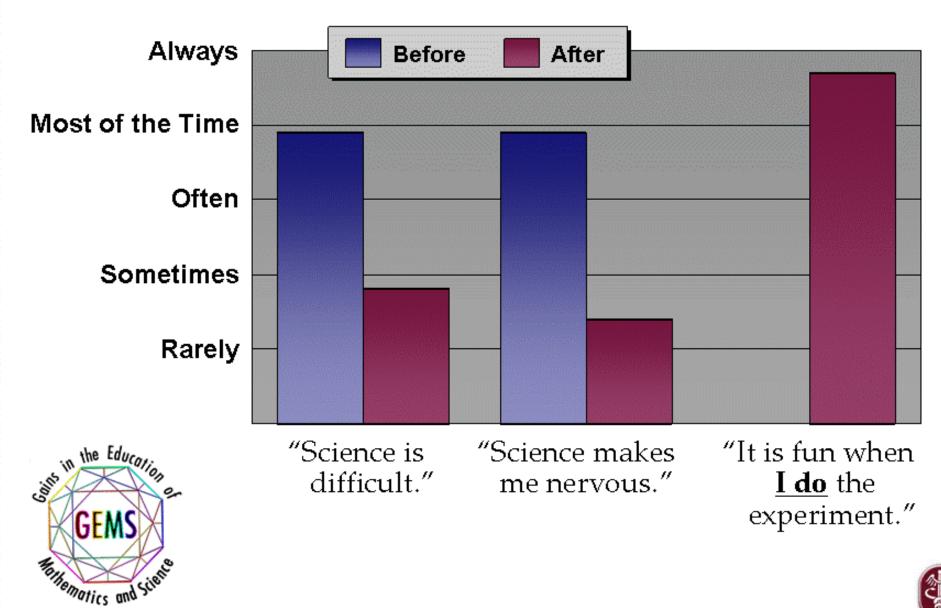
Program Evaluation 101

- How can we make positive statements about our programs?
 - Evaluation of student progression through programs over a period of 10-12 years.
 - Attitudinal pre- and post-surveys to support the value of program process.
 - Surveys for mentors, near-peer mentors, participants in GEMS, SEAP and SEAP CQL (not every year and not always every participant).
 - Formative and summative utilization of pre- and post-surveys guide use of modules and lectures (formats for learning) during the summer and across years, evaluate near-peer mentors, inform as to value of teacher inclusion in the GEMS laboratory and educate us as to where students have learned specific skills.





Feedback Before and After GEMS Internships (149 Students)





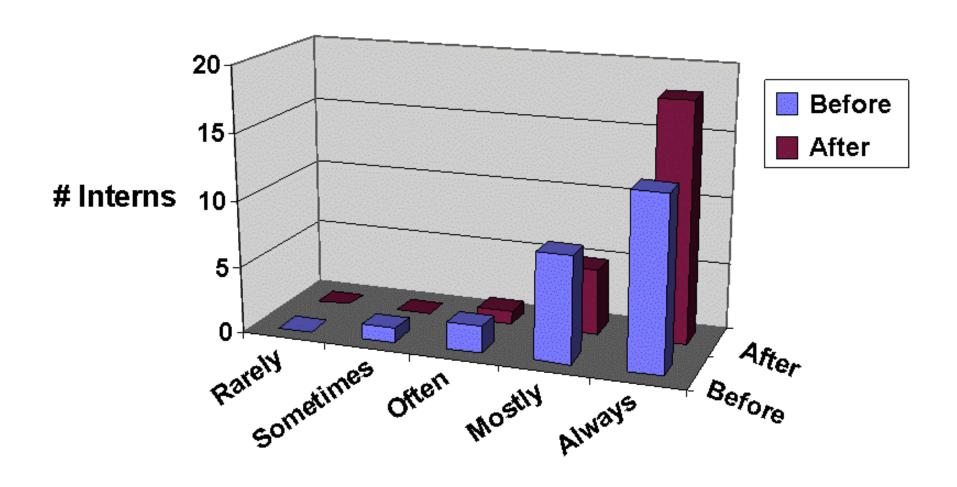


Prog. Eval. 101 cont. Instruments of Evaluation

- Attitudinal Pre- and post-surveys for participants were developed and utilized in 2000 and continue to be used and redeveloped by clinical/research psychologists and scientific staff.
- Exit interviews with near-peer mentors (about their experience and rating of continuing GEMS participants), SEAP participants and GEMS.
- "Brag" letter 600-1000 letters sent to parents to determine program impact, change in children's attitudes toward all learning and current educational status of participants.
- For 2005, age/gender matching of program participants with those students invited to participate but unable to do so due to schedule conflicts (must include all reasons – jobs, vacations and other educational opportunities) – best method of determining program impact. Should not ordinarily be done historically. Requires novel survey development.
- Education Partnership Agreements (or equivalent) with impacted educational system and human use protocol (IRB, HSRRB, HURC) allow for use of GPA, course selection, standardized test scores etc. (under human subjects protections with de-identified/coded or anonymous data) to be compared for participating and nonparticipating age- and gender-matched students.
- Program Comparison SEPA Directors' Meetings and site visits by other SEPA programs (program officials from University of Wisconsin, Arizona and others), visits to program sites (ARL, Salesh-Kootenai College, MT), exchange of site visits with directors of Step-Up (University of Ulster, Northern Ireland, visits with schools).
- Content-based pre- and post-surveys for participants when specific, finite material can be learned. Can be based on standardized testing but very difficult to do. Material World Modules used this approach at Garrett College and their program processes, investigators and instruments were approved under WRAIR's educational human use protocol.



Self-confidence: I can make a meaningful contribution through my abilities and efforts



N=24 GEMS Interns Level 3





Why evaluate?

- Provides more than anecdotal evidence or example. No assumption of value but rather evaluation provides evidence of change.
- Program improvement and advancement formative and summative utilization
- Have an answer for NIH, DoD/Army, parents, schools, other program directors when they ask "Does it really make a difference?", "Will it benefit our students or serve our needs?", "Is it a valuable use of inschool time?".
- Evidence for current and future funding NSF, NAS, NIH, DoD/Army, non-profit organizations (Gates Foundation, HHMI), business/industry (specific skills needed). Percentage of funds on many grants must be used for program evaluation. Pilot data is critical to increase probability of funding.
- Expansion to new sites, locales rural vs. suburban vs. urban (Where has it worked? Where will it work?)
- It is not scrutiny but rather opportunity to reveal the value of a program.
- Must not lose important data implement as soon as possible.





Evidence for Funding!

- Providing input for Academic Competitiveness Council (President Bush through his January 2006 State of the Union Address and his Academic Competitiveness Initiative)
- DoD and NIH requests for program evaluation data (Starbase and GEMS responding for DoD and all mature SEPA programs and others responding with data/complete program information for NIH)
- Most dire consequence -- Without proof of educational efficacy through rigorous program evaluations (Randomized Clinical Trials; Accountability or testing being one of the pillars of No Child Left Behind), funding for DoD and NIH educational programs may be reallocated to Department of Education through Office of Management and Budget actions.

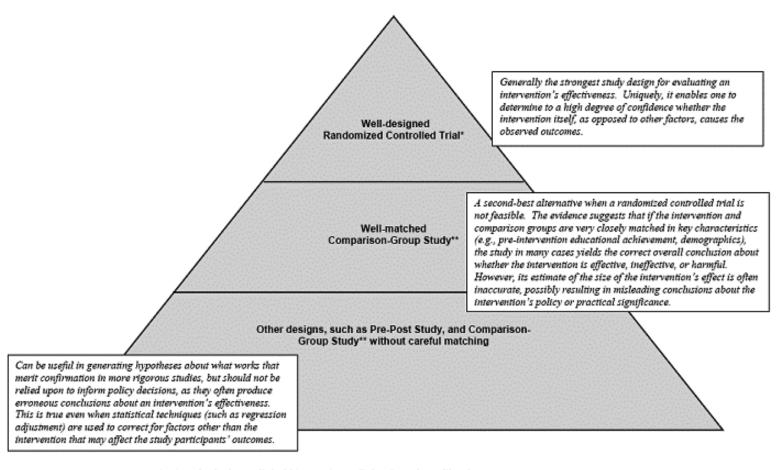




Academic Competitiveness Council Hierarchy of Study Designs – Rigorous Evaluation

Graphic Summary:

Hierarchy of Study Designs For Evaluating the Effectiveness of a STEM Educational Intervention

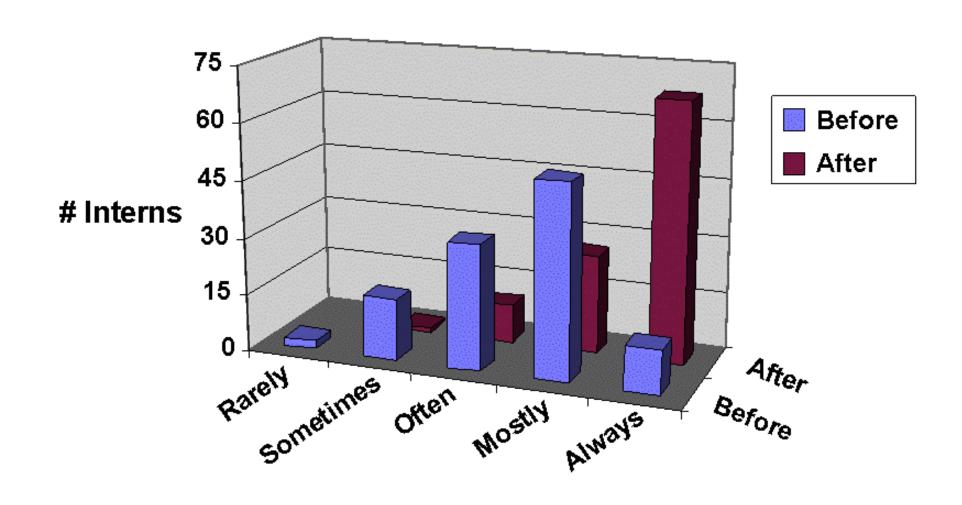


- A randomized controlled trial is sometimes called an "experimental" study.
- ** A comparison-group study is sometimes called a "quasi-experimental" study.





Self-Confidence Relating to Tasks in Science



N=102 GEMS Interns Levels 1-2





GEMS







Questions and Acknowledgements

- Dr. Robin Haller, private clinical psychologist
- Dr. Laurie Ryan, clinical psychologist, formerly of the Defense and Veterans
 Brain Injury Center and now with the National Institute on Aging.
- Dr. Margery Anderson, former GEMS Program Administrator for Science Education (Catherine Anderson, statistical support) and now Director, International Science Olympiad, Center for Excellence in Science Education.
- Mrs. Jill Morton, M.S. Eng., current GEMS Program Coordinator.
- Tarik Williams, Funmi Obiri, Steve Fox, Miriam Cabezas, Dr. Michael Koenig, Jordan Tenenbaum, Dr. Chanaka Mendis, Dr. Rina Das, Dr. Rasha Hammamieh, Dr. Jeffrey Schupp, Dr. Sachin Mani, Dr. Timothy Bentley, Stacey Ann Miller, and many other important mentors and near-peer mentors.....
- Mr. George Tilton, J.D. and Dr. Jeffrey Yourick
- Many, many D.C. City-wide Science Fair judges

















Fort Detrick and National Interagency Confederation for Biological Research (NICBR)

Frederick County Public Schools

Dr. R. Daniel Cunningham



Deputy Superintendent

The Importance of Partnering With Schools

R. Daniel Cunningham, Jr., Ed.D. Deputy Superintendent, FCPS

"Across the nation, from the smallest towns to the largest cities, the quality of virtually every community is defined by its public schools."

The Council for Corporate Partnerships

FCPS Goals

- Equip all students with the knowledge and skills to achieve their full potential
- 2. Provide a safe, inviting learning climate
- 3. Attract and retain highly qualified, effective employees
- 4. Engage all community sectors in education
- 5. Advocate for adequate resources and manage them accountably

Why Community Involvement?

- When schools and communities work together, both are strengthened in synergistic ways and make gains that outpace what either entity could accomplish on its own:
 - Families access community resources more easily;
 - Businesses connect education programs with the realities of the workplace;
 - Seniors contribute wisdom and gain a greater sense of purpose; and ultimately,
 - Students serve and learn beyond their school environment.
- The best partnerships are mutually beneficial and structured to connect individuals, not just institutions or groups. This connection enables the power of community partnerships to be unleashed. *Harvard Family Research*

Why Community Involvement?

- It has been estimated that 40–50 percent of what a child learns occurs in school and the remaining 50-60 percent comes from the family and community.
- "Without close articulation of and involvement with the family and larger community, schools will ultimately fail"

(Partnership for Learning 12996, p. 14).

Are there Partnerships? How many and what?

- Currently, there are 150 formal business partnerships!
- These range from:
 - Internships
 - Sponsorships
 - Equipment Dispersal
 - Academic Incentives
 - Others

Work Based Experiences

- Cooperative work-study
 - Approximately 500
- Internships
 - Approximately 300
- Service Learning
 - Approximately 700



Work Based Experiences Who Are the Students?

- More male than female
- Majority 12th Grade students
- Predominately in Human Services job fields
- All high schools represented



What Do Our Work Based Partners Say?

- 98.9% of students met or exceeded minimum entry requirements at beginning of experience.
- 98.8% of students met or exceeded minimum workplace readiness skills.
- 99.1% of students met or exceeded minimum skills for success at time of employment.
- 99.2% of students learned new job skills with average or less than average instruction.

Compiled by MSDE



Important Ingredients

- Improve student motivation
- Provide future direction for students
- Improve academic achievement
- Ability to resolve problems
- Communication and assignment of roles
- Quality of service



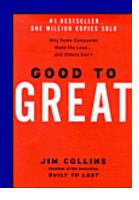
Guidelines for Partnership Development

- Clearly defined and mutually developed goals
- Be collaborative and benefit for both parties
- Aligned with mission and goals of school system
- Be embedded into the school program
- Have a management plan that defines roles
- Plan for sustainability
- Have a plan of evaluation
 - Short and long-term

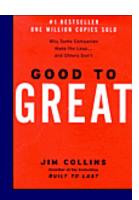




- For a social sector organization, performance must be assessed relative to mission, not financial returns. In the social sectors the critical questions is:
 - "How effectively do we deliver on our mission and make a distinctive impact, relative to our resources?"







- It doesn't really matter whether you can quantify your results. What matters is that you rigorously assemble evidence—quantitative or qualitative—to track your progress.
- If the evidence is primarily qualitative, think like a trial lawyer assembling the combined body of evidence.
- If the evidence is primarily quantitative, then think of yourself as a laboratory scientist assembling and assessing the data.



"All organizations are aligned to get the results they get."

■ Arthur W. Jones

What will make the difference to meet today's challenges?

- Our attitude
- Our commitment
- Our willingness to think and do things differently.

Contact Information

James Ferrant

James.Ferrant@fcps.org

■ Phone: 301-644-5121

- Dan Cunningham
 - Dan.Cunningham@fcps.org
 - Phone: 301-696-6800



Questions or Comments

"Tailor schools to meet the needs of the school, the community and the business."

Source: Council for Corporate and School Partnerships















Fort Detrick and National Interagency Confederation for Biological Research (NICBR)

Office of the Secretary of Defense

Keith Thompson





DoD STEM Education Strategy

Maryland Business Roundtable for Education

DoD POC: Keith Thompson, (703) 588-1390, keith.thompson@osd.mil



Outline

- Why DOD is involved in STEM education
- DoD assets
- Coalition model
- Maryland pilot project
- Potential partnerships in Maryland



Problem Overview

What we care about, and why...

Assure High Quality Science, Technology, Engineering and Mathematics Workforce.

Science and Technology provides a vital force multiplying effect & US "battlefield" advantage

Sustaining U.S. Leadership in S&T requires

- World Class Technical Talent
- State-of-the-Art Infrastructure
- A Dynamic Innovation System

If the US loses its Technology Advantage --National and Economic Security are At Risk



DoD S&E Challenges

- Attrition in DoD labs
- Unfilled needs in critical technologies
- Thinning supply of clearable students acquiring defense-related skills
- Increased competition for the best and brightest

Projected <u>U.S. demand</u> for:

Scientists will be up 17% and

Engineers will be up by 22% by 2014

(November 2005 BLS Monthly Labor Review.)



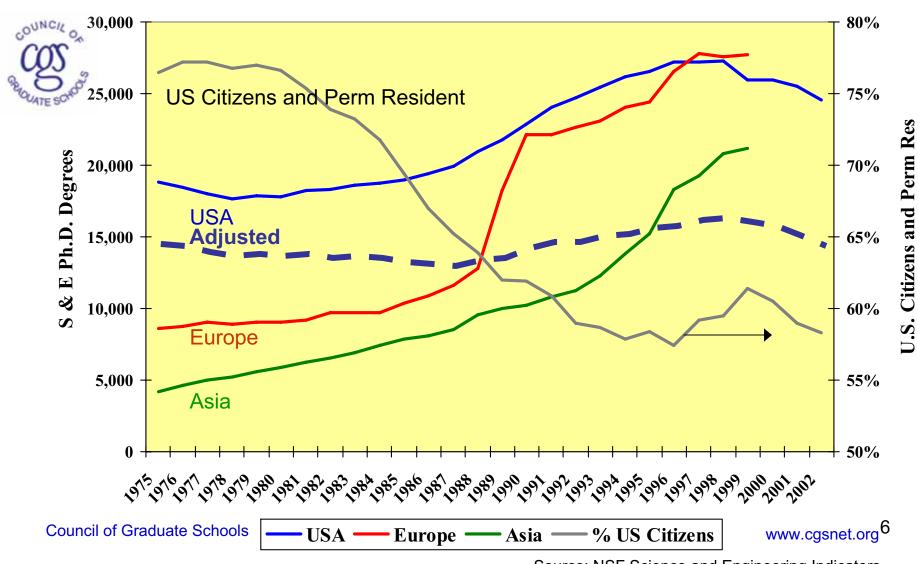
A National Issue

12 major studies (1999-2006) have pointed up key U.S. vulnerabilities in science, technology, engineering, and mathematics (STEM)

- Under-performance of K-12 education
- Stimulating interest in STEM disciplines/careers
- Attrition in post-secondary STEM education
- Graying of the workforce



Doctoral S&E Degrees by World Region





World Technology Leadership

20 Technology Areas

Agricultural Science <a>X
Biology & BioChem

Chemistry -X

Clinical Medicine

Computer Science*

Ecology & Enviroment

Engineering <u>X</u>

Geoscience

Immunology*

Materials Science -X

Math

Microbiology

Molecular Bio & Genetics*

Multidisciplinary*

Neuroscience*

Pharmacology <a>X

Physics -X

Plant & Animal Science

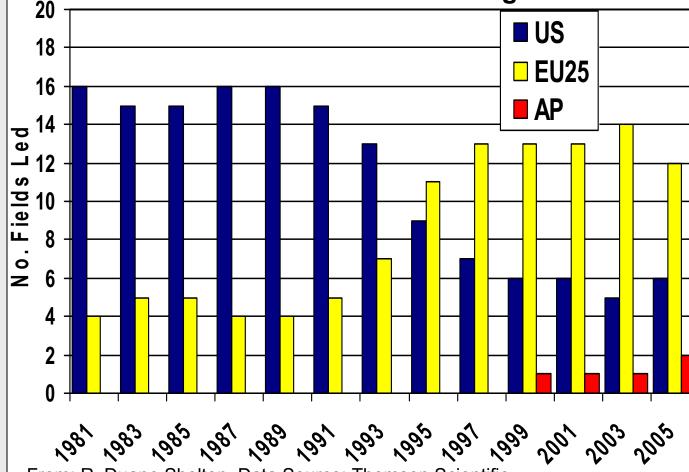
Psych & Psychiatry*

Space Science

(*Led by US in 2005)

X US is third in 3 way race





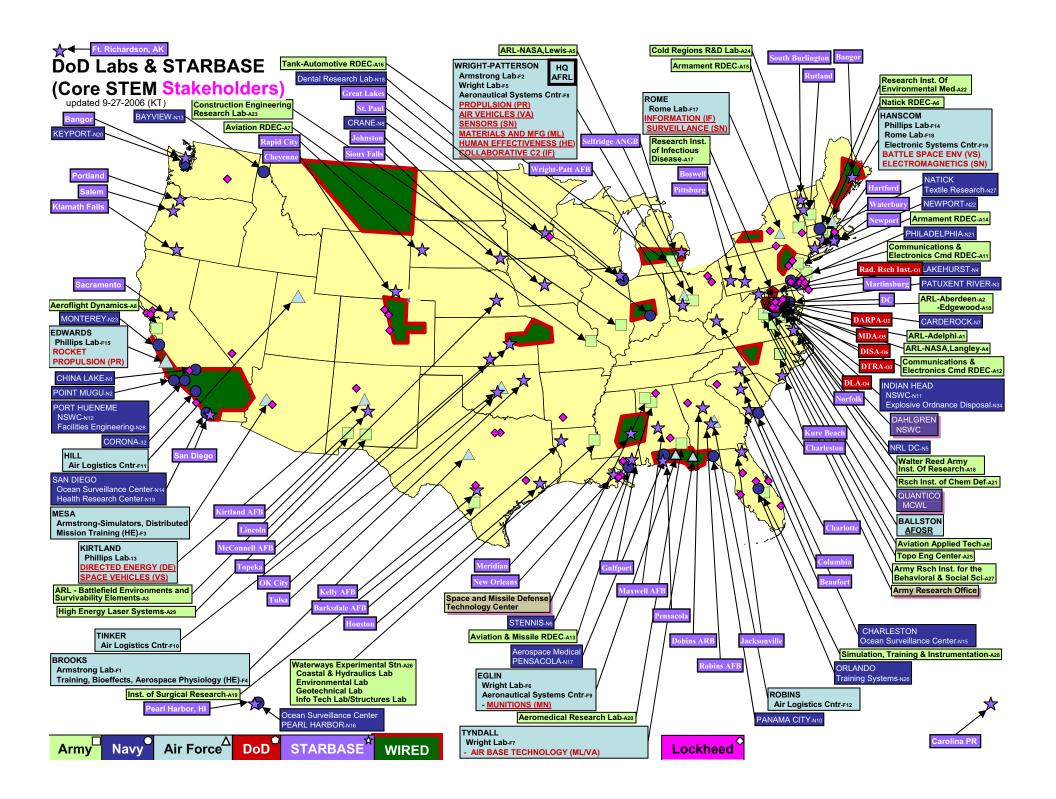
From: R. Duane Shelton, Data Source: Thomson Scientific, National Science Indicators, ISI 2006, Copyright retained US= United States, EU25= European Union, AP= Asia Pacific

Kt mod-10/4/2006



What DoD Brings to the Table

- Cutting edge tools, facilities and experts
- Distributed state-of-the-art research assets
- A large pool of committed volunteers
- Significant industry and university partnerships
- Far-reaching Congressional authorization in education and workforce development
- Many ongoing local and national programs
- High level of commitment including resources





Strategy

Recognize: Going it alone will continue to achieve marginal gains

Engage – Collaboratively and Comprehensively

- Perspective -- Address the <u>Pipeline</u>
 - Identify effective activities at all levels, K-graduate
- Pathways Connect Learning to Life & STEM Careers
 - Link in-school and lab-based opportunities
 - Engage students as they progress through the continuum
- Partnerships -- Build Coalitions
 - Industry, State & Local Education Authorities, Educators, Academia, and other Government Agencies
 - Defy the Not-Invented-Here mentality



Coalition Model

Activity Characteristics

Inquiry-Design Methodology

Linked to Life

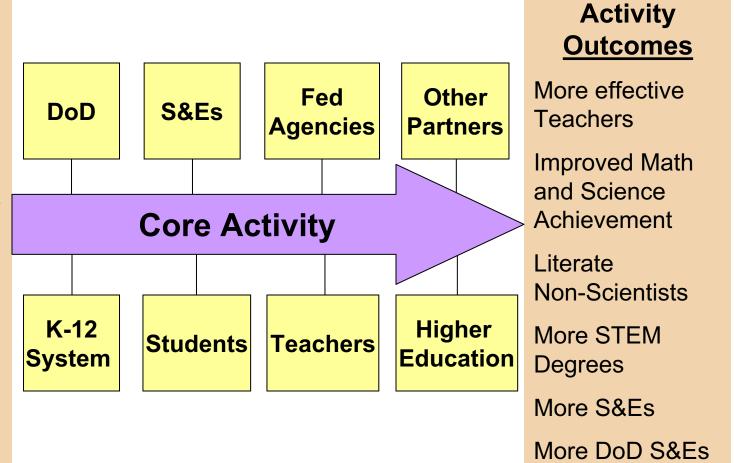
Demonstrated Effect

Teacher Training

Mapped to Standards

Adoptable/ Adaptable

Cooperative/ Collaborative





Objectives

Internal

- Align assets around a coordinated strategy
- Identify and Use effective approaches

External

- Create momentum around a single, specific effort
- Foster a national culture of collaboration in STEM education
- Recognize, Adopt and Repeat:
 No organization can build capacity on the scale that is required on its own We Must Work Together

.....Work Together On What?



One Specific Effort

This effort meets all the criteria:

Materials World Modules

- Interdisciplinary approach to Inquiry-Based Learning
 - Inquiry-based approach simulates the methodology used by DOD and Industry to develop technologically advanced products
- Curriculum enhancement developed and refined over 10 years by internationally recognized researcher
- Enables real-world application of textbook concepts
- Mapped to MD Standards (and others)
- Field-tested, evidence-based
- Lots of opportunity for collaboration
- MWM offers far more than just MWM it's a rally point



DoD Approach to MWM Scale-Up

- Invest ~ \$15 million over (3-5) years to establish a sustainable program
- Leverage community college network to disseminate program and train teachers
- Demonstrate that <u>collaboration</u> <u>at scale</u> can occur through regional consortia
- Measure program effectiveness through rigorous evaluation



Rationale For Maryland Pilot

- High concentration of research labs including DoD, NASA,NIH, NIST
- Progressive force in STEM education
- Diverse economy and student population
- Many science and technology-based employment opportunities
- If we can't do it in Maryland...



Goals in Maryland

- Develop an implementation model that can be replicated
- Develop lessons learned that can applied around the country
- Produce outcomes that capture national attention



Partnership Opportunities

- Leadership
 - take the lead near your facility
- People
 - Scientists and engineers
 - Support for classroom teachers
 - Support for after-school efforts
 - Coordination requires a Coordinator
- Resources
 - Funding
 - Facilities

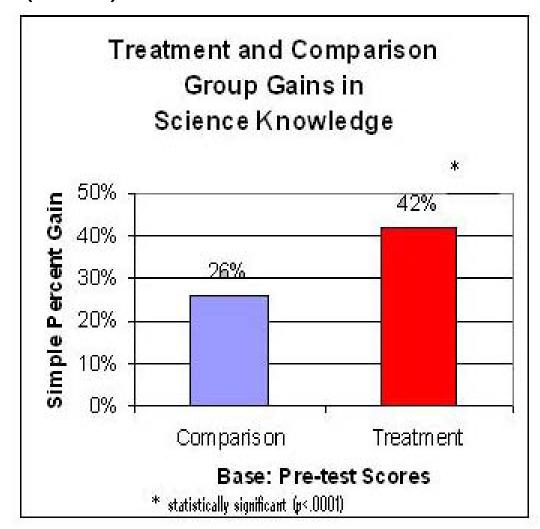
Joining the effort will bring other opportunities into view



Results of 2006 Summer Institute

Impressive Gain (62%) over Control in

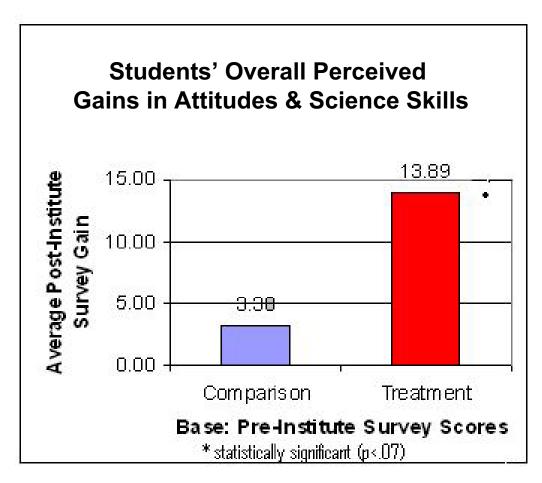
Science Knowledge





More results

High Attitudinal shift



Materials World Modules

Northwestern University Materials World Modules (MWM)

- Secondary School Curriculum
- Pedagogy integrates Inquiry and Design

Inquiry cycle Design cycle

- Students complete a series of hands-on, *inquiry-based* activities in each module
- Each module culminates in design challenges
- Students simulate the work of scientists (through activities that foster inquiry) and engineers (through activities that emphasize design)

- Identify question.
- Propose explanation.
- Create and perform experiment
 - Based on results. refine explanation

Goal: Working explanation

- Identify problem.
- Propose design.
- Build and test prototype
- Based on results, redesign product.

Goal: Functional product



Engineering















Fort Detrick and National Interagency Confederation for Biological Research (NICBR)

Walter Reed Army Institute of Research

Dr. Marti Jett





USAMRMC Programs offering Scientific Training Opportunities

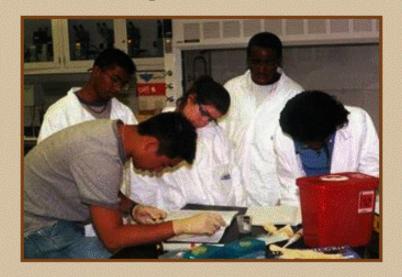
Marti Jett, Ph.D

Chief, Dept Molecular Pathology

Debra Yourick, Ph.D

Assoc. Dir, Res, Marketing & Policy

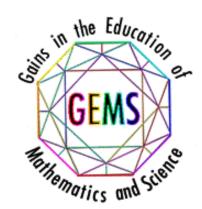
Walter Reed Army Institute of Research







Programs



 Gains in the Education of Math and Science (GEMS). 8-12th grade students. Provides opportunities for lab sciences to any interested student. Established in 1994



 Science and Engineering Apprentice Program (SEAP). 11-12th grades for wellqualified students. Established 1980



 College Qualified Leaders (CQL). Provides trained laboratory workers for DoD labs and offers them additional work experience, scholarship and educational opportunities



Science and Engineering Apprentice Program (SEAP)

Initiated in 1980 by Dr. Lin Krupsaw (Electrical Engineer)
She persuaded DoD to accept summer high school interns

- Eight week summer internship allowed advanced high school students to work with experienced DoD scientists in the laboratory
- Work as part of the DoD research team, applying efforts to ongoing research projects as an apprentice not just a teenager
- At end of summer, students are required to prepare 10 page final research report and present findings in a seminar format
- Students often contribute to research and become co-authors on scientific manuscripts



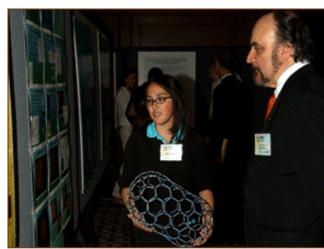


SEAP - Benefits

- Encourage students to pursue science and engineering careers
- Provide students with opportunities in and exposure to scientific and engineering practice and personnel not available in their school environment
- Develop a student/citizen appreciation for the process and rigor of scientific research with a view towards potential govt service

 Prepare these students to serve as positive role models for their peers by encouraging other high school students to take more

science and math courses





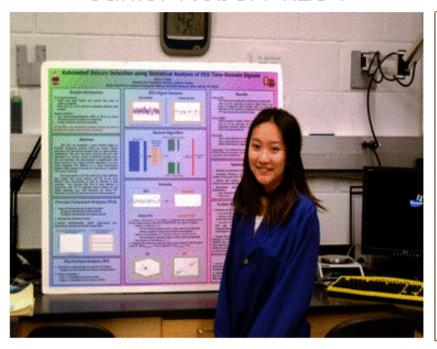




SEAP Outcomes and Successes

Outcomes –

- Students apply their skills to science fair projects and win scholarships that will enable them to pursue science careers.
- Intel Science Talent Search. Yearly, we have 1-2 semifinalists among 300 students selected from >10,000 nationwide
- 2005 had a finalist (one of 40 students nationwide). Called the "Junior Nobel Prize".



Sherri Geng was Mentored by Dr. Lucille Lumley at WRAIR.

The task was to establish algorithms to identify infrequent seizures from continual EEG monitoring of rats exposed to chem agents. Sherri taught herself Mathematical modeling/algorithm development using Mat Lab and produced a successful automated program



Recognizing the need for GEMS

SEAP focused on the students who were mature and somewhat experienced

- We observed that the 7-9th grade students were the ones eager to talk about science projects and showed incredible enthusiasm and awe about exploration
- If students were not pushing themselves to take highlevel math by 7-8th grades, their opportunities for a career in STEM would be diminished.
- They needed opportunities and examples of scientific career possibilities.





Gains in the Education of Mathematics and Science (GEMS)



GEMS Program Philosophy

- The GEMS program aims to identify scienceenthusiastic youth, especially those who lack scientific opportunities to excel.
- The goal is to find them early enough to positively mold their fate and brighten their future with lifelong learning
- GEMS has been the spark to launch youngsters into scientific careers, and also has created a citizenry with positive attitude to science.

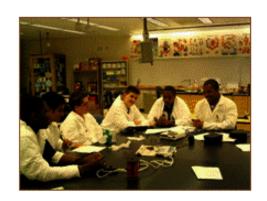




Key elements of GEMS programs



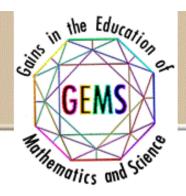




- Near-peer mentors (college students) lead young Jr/HS students as they carry out exciting experiments (in small groups, 4-6). They personify values in learning, talk about the need to take high level math and other courses. Learning is fun, relaxed and without criticism.
- Near-peer mentors are selected for their diverse backgrounds and strong ability to interact and teach. GEMS participants have become near-peer mentors themselves and are able to understand the younger students' experiences
- Successful GEMS students return year after year as they move from middle school to high school, and perform progressively more difficult experiments and grasp more complex concepts (GEMS-1, -2, -3)



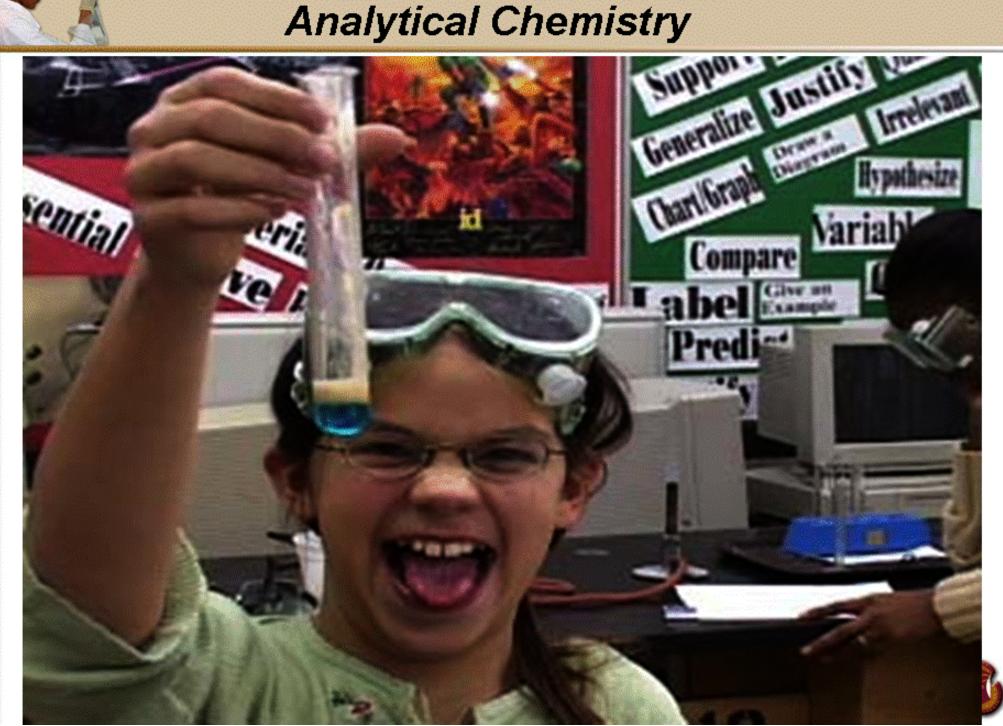
GEMS 1–3



- Three GEMS Levels for varying levels of previous science experience. Each builds on the previous years work
 - GEMS 1: A one intensive week carrying out simple biology, chemistry and physics experiments to increase interest in science and overall learning.
 The object is to cast a broad net and demonstrate that carrying out lab experiments is fun and rewarding. All are invited-stipend is \$50-100
 - GEMS 2: One to two week programs with more complex work, building on the techniques learned during GEMS 1. Work may include examination of neural toxicity, dissection of mosquito salivary glands, chromatography, etc
 - GEMS 3: A four week experience using complex state-of-the-art scientific tools and techniques, such as gene cloning. Students are required to complete a 5-page research report and poster to document their results
 - THOROUGHLY LEARN COMMON LAB TECHNIQUES, DECORUM, E



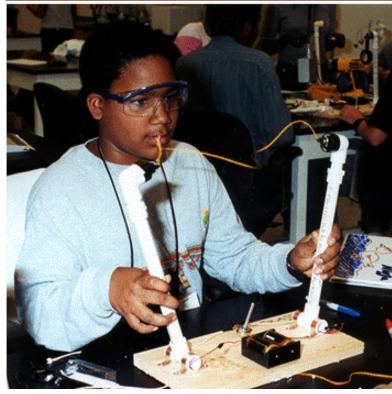
GEMS 1 Module: Analytical Chemistry





Benefits include new skills, self-confidence

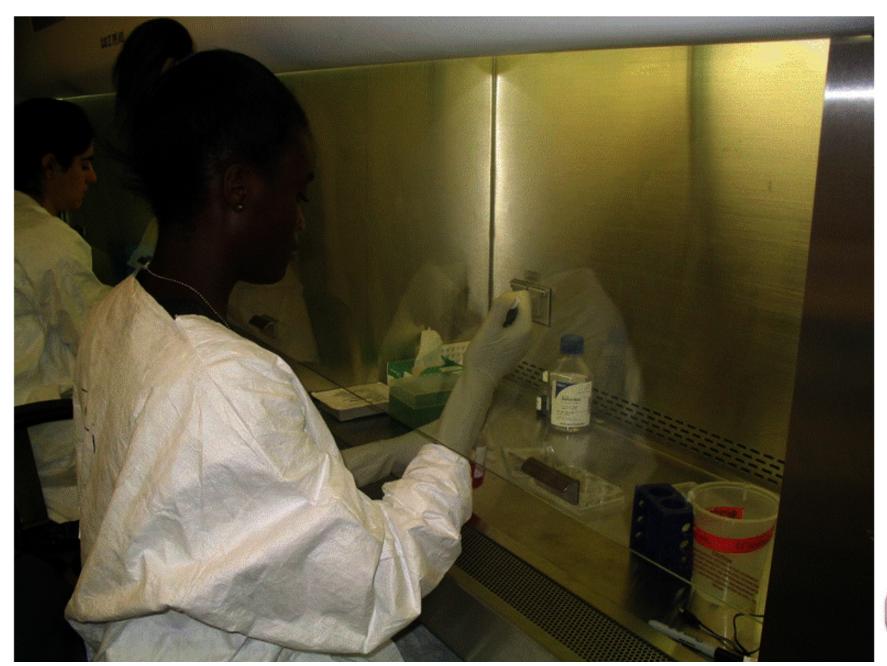








GEMS 2 Module: Neurotoxicity and Breast Cancer Proliferation Studies in Culture





Rasha Hammamieh, Margery Anderson, Katharine Carr, Christine N. Tran, Debra L. Yourick, and Marti Jett (2005).

Students Investigating the Antiproliferative Effects of Synthesized Drugs on Mouse Mammary Tumor Cells. Cell Biol. Education 4:221-235

Thank you so much for sending me the good news about the publication of our article. I am so happy and proud to see it in print!

I hope that all goes well with you this year, especially with the GEMS and SEAP programs. As for me, I'm in the second, very hectic week of classes. So, I've been busy getting to all 6 of my classes (most of them chemical engineering courses) and keeping up with my extracurriculars. I'd just like to let you know that the summer working with the GEMS students has really motivated me to keep up with that sort of work. This year, I'll be in charge of organizing high school outreach events for the Ithaca youth to get them more involved in science and engineering fields. I'll definitely be keeping GEMS in mind when thinking up creative ways to accomplish this goal!

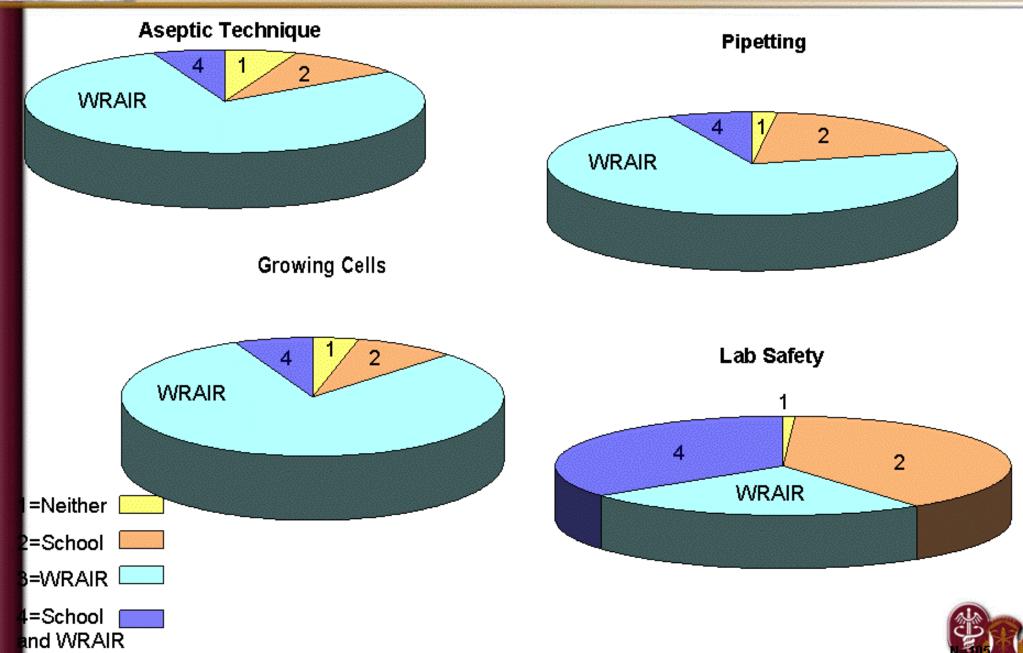
If you have time to, please let me know how you're doing. I'll always love to hear from you. For now, I wish you all the best at WRAIR.

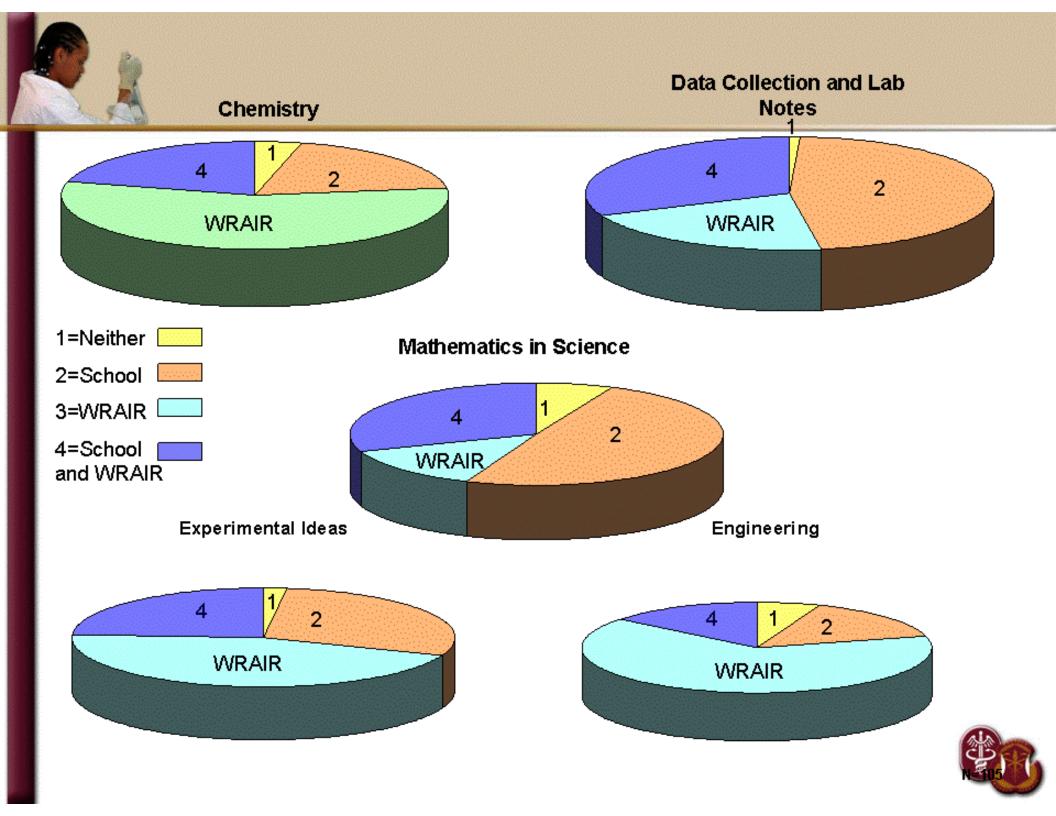
Regards, Christine





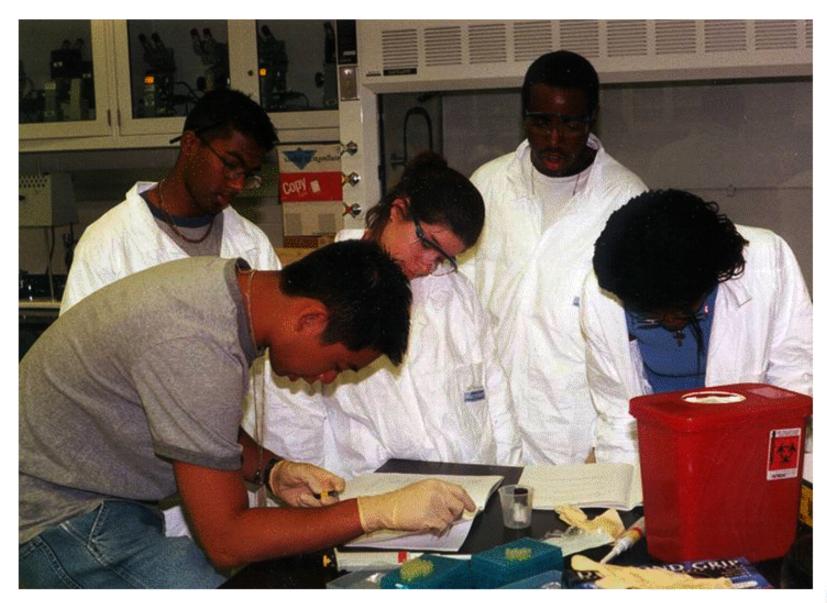
Where did you learn to do the following?







GEMS 3 Module: High-throughput Gene Cloning







Outcomes and Successes

One Example of Success – Marquita

- Awarded an internship at WRAIR as a rising 8th grade, continued 6 years
- Her school had only 24% of students achieve proficiency in Math & English
- She said, "Near Peer Mentors were key to her keeping focused"
- Made Dean's list yearly at Spellman College, Math Major, Biochem Minor
- Now a first year medical student at U. Pittsburgh

Yrs 1-2 Yr #3 Yr #4 Yr #5 Yr #6

GEMS 1	GEMS 2	GEMS 3	High Sch	nool (SEAP) College Students	
8th-12th	10th-12th	11th-12th	11-12 th	12 th	Undergrad	Graduate
1 week program	2 week program	4 week program	8 week program	Mentor- ship	Research assistant	Mission research
Introduc- tion to skills	5 day investi- gation	Experi- mental design	Appren- tice and leader	Advanced project	Indepen- dent In- vestigation	
Guided by Guided by Undergrads. and Graduates Undergrads. and Graduates					Guided by Grads	Guided by Scientist

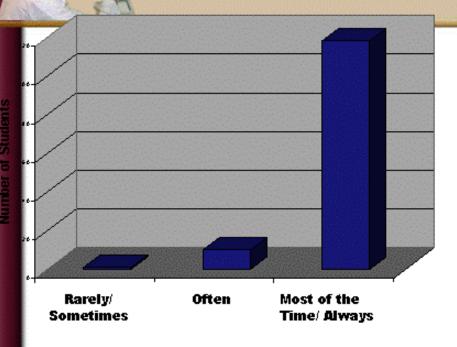


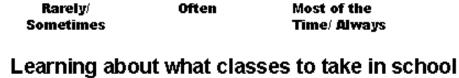
At GEMS I Enjoyed

Number of Students



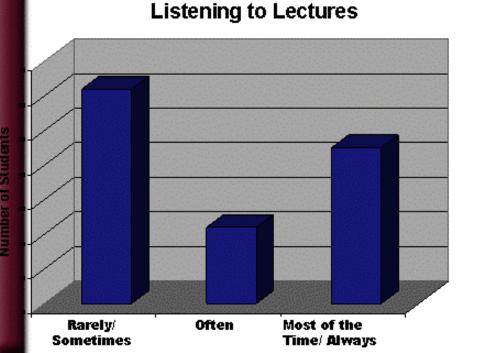
Working on labs with other students

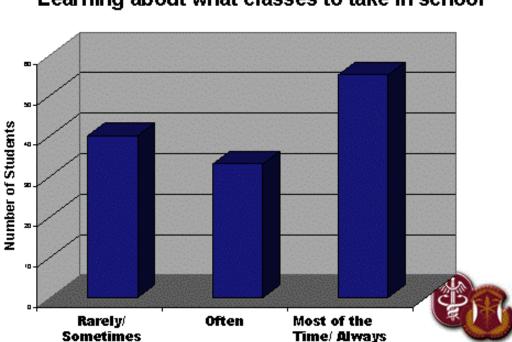




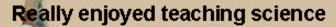
Most of the

Often

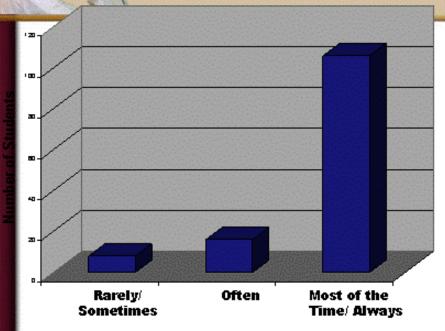


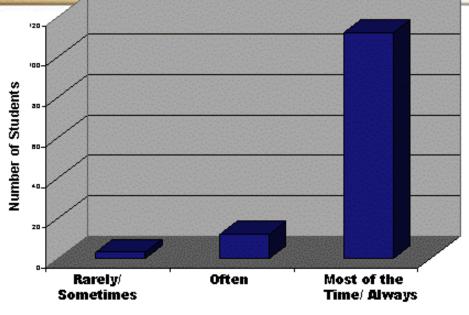


My College Leader (near-peer mentors)



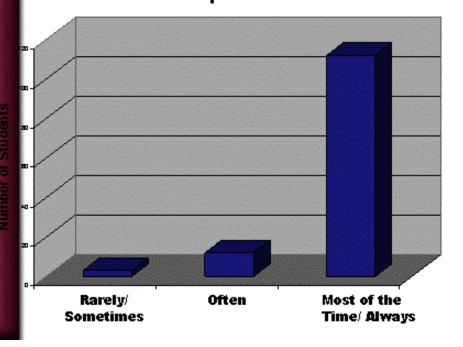
Expected me to do my best at all times

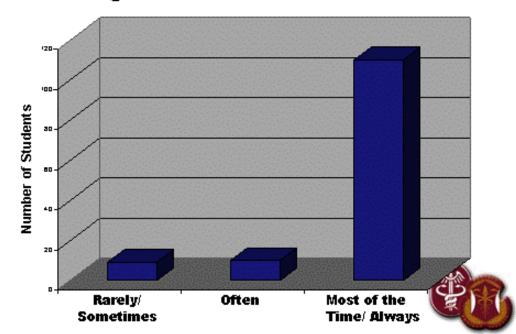




Gave me extra help when I did not understand

Encouraged me to think about a career in science





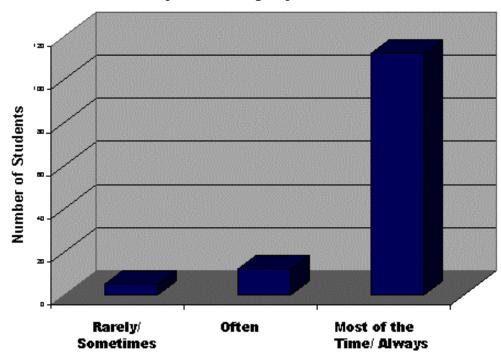
My College Leader (near-peer mentors) Were role models Made science exciting

Respected my opinions and ideas

Rarely/

Sometimes

Often



Rarely/

Sometimes

Often

Most of the

Time/ Always



Most of the

Time/ Always



Near-peer mentors say:

"The biggest positive to me was exposing the kids to what was going on in the labs upstairs...It was great to expose the kids to some of those, you know, truly innovative stuff that's going on at WRAIR."

"...they (mentors) trusted me to get things done and to get them done in a timely manner."

"I guess it even exceeded {my expectations}, working in an actual lab where real research was actually going on. I guess it just kind of almost blew my mind. I was just amazed."

"It made me more assertive in situations and ...more a leader and it definitely boosted my confidence."

"...gave me an appreciation for a variety of different people. I was surprised at how people could, you know, different backgrounds and even of different countries and speak different languages could just come together and work so well with each other, and actually make progress on projects and research."

"...just the people I work with, the whole positive attitude, the positive environment, just makes you want to do work and just putting all your effort into it."



Comment from a Near-Peer Mentor, 2006

"Rewarding in the sense that I finally found myself working at a place that made a difference."





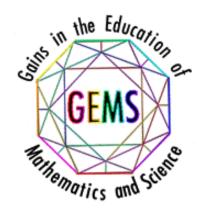
GEMS is readily disseminated

- Each additional site introduces new excitement, clever experimental studies and scientists eager to participate
 - USAMRIID (Summer 2006) Dr. Beth Leffel
 - George Washington University (3 years)
 - ARL-Adelphi and APG-Aberdeen Proving Ground (2 years)
 - Redstone Arsenal (Huntsville, AL)
 - Salish Kootenai College on Flathead Indian Reservation
- Sites are diverse and include Universities, research labs, public schools





Funding these Educational Programs



 GEMS has been supported by NIH as an innovative experiment in teaching science and is a race / gender equity program.
 Science Education Partnership Award Grant no. 5R25RR018619-03 (6 years)



 SEAP administration is funded by the Army at George Washington University, but stipends are provided by individual labs



CQLs are supported entirely by individual laboratories utilizing their own RDTE funds



College Qualified Leaders (CQL) – Goals and Objectives



- Afford professional scientists the opportunity to have fully trained students return to their laboratory during their college years
- Give mentors the opportunity to share their passion for science with talented undergraduates
- Give college students, both graduate and undergraduate, the opportunity to continue their research and training in a single laboratory
- Educate undergraduates and graduates about the research process by performing actual research
- Students have the opportunity to work in the same laboratory throughout the year, not just for a few weeks in summer





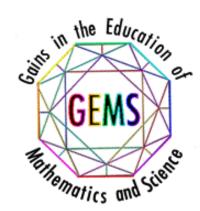
CQL - Benefits



- Prepare a new generation of scientists and mentors
- Provide a learning community for the developing professional in DoD laboratories
- Many students are included on full publications and make presentations at national scientific meetings
- Used by several USAMRMC laboratories and is expanding
- Transition to contract or fellowship status with attainment of Ph.D. (or M.D.) is possible
- CQLs have also been made civilian employees depending upon availability of slots and longterm funding

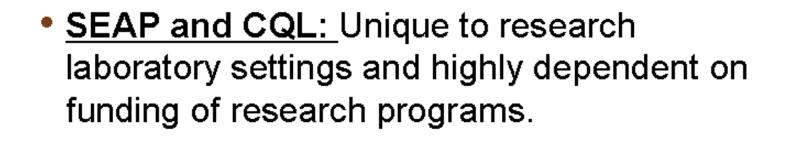


Program growth



 GEMS and CQL near peer mentors: Infinitely expandable























Fort Detrick and National Interagency Confederation for Biological Research (NICBR)

Bechtel ACE

Carrie Arnold-Gutierrez





ACE Mentoring Program A Way Forward...

career directions for students in architecture, construction and engineering









Frederick Chapter
Presented by:

Carrie Arnold-Gutierrez



Why and How?

career directions for students in architecture, construction and engineering

Why are students not pursuing degrees in A-C-E?

- Lack of knowledge
- √ Lack of encouragement
- Afraid to fail

ACE National

- Birth of ACE
- ✓ Mission of ACE "mentor," inspire and motivate
- √ 20,500 students introduced to A-C-E careers
- ▼ Provides affiliates infrastructure, guidelines, mentors, and materials



Who, Where, and When?

career directions for students in architecture, construction and engineering

ACE Frederick Chapter

- ✓ Launched in 2005
- Students from all 9 Frederick County high schools
- ▼ 15+ mentors from Bechtel and 5 or more guest speakers/presenters
- Currently have 47 this year
- Meet at Bechtel, 15 times throughout the year



What?

career directions for students in architecture, construction and engineering

Program Consists of:

- ▼ Introduction to technical side of "building industry"
 - Management
 - Engineering
 - Architecture
 - Construction



- ✓ Hands-on exercises and activities
- ▼ Team projects Plan, design, estimate, schedule and model
 - Role play in project positions
 - Presentation, sell their project





Benefits

career directions for students in architecture, construction and engineering

- Career guidance
- Business connections
- Challenges
- Encouragement
- Role models
- Internship opportunities
- Scholarship opportunities

♥ Business:

- Give back to the community
- Networking in community and with businesses on a national level
- Begin recruitment of future workforce
- Connection to local schools, colleges, and universities



Big Picture Benefits

career directions for students in architecture, construction and engineering

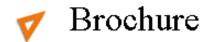
- ✓ Improve talent supply to meet the future demand
- Work together to share the responsibility to meet the future
 - Schools, colleges, and universities
 - Businesses
 - Students
 - Parents





Conclusion

career directions for students in architecture, construction and engineering



▼ Web Site – www.acementor.org

















Fort Detrick and National Interagency Confederation for Biological Research (NICBR)

NCI Elementary Outreach & Werner H. Kristen Student Internship Programs

Barbara Birnman



Werner H. Kirsten Student Intern Program (SIP) and NCI-Frederick Elementary Outreach Program (EOP)

National Cancer Institute - Frederick

SIP Information

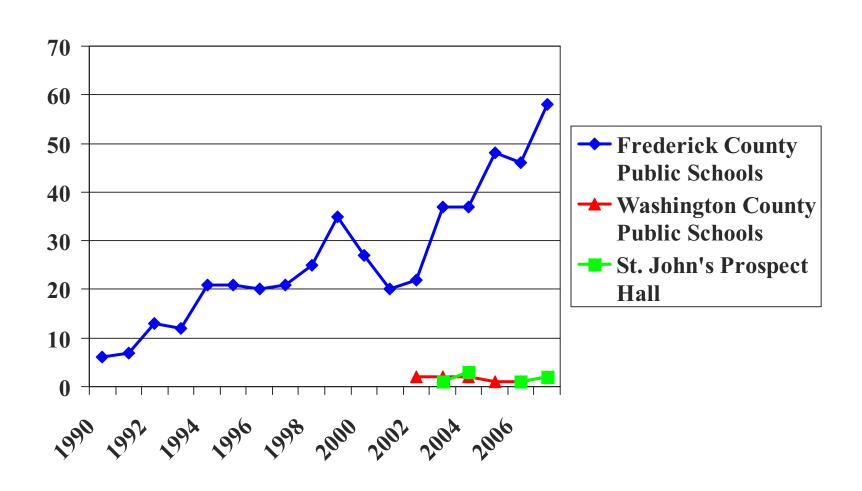
- Opportunity for high school seniors to intern in research (e.g., laboratory) or scientific support (e.g., scientific library, web development, graphic arts, and publications) in a biomedical research environment.
- Is a well respected internship by colleges and universities.
- Allows students the possibility to return for summer employment during their college years.

SIP Partnerships

- Maryland
 - Frederick County Public Schools (FCPS)
 - Washington County Public Schools (WCPS)
 - Saint John's at Prospect Hall (SJPH)
- West Virginia
 - Jefferson County Public School (JCPS)



SIP Students from 1990-2007



NCI-Frederick Elementary Outreach Program (EOP)

- The Elementary Outreach Program provides the opportunity for elementary school students to receive supplemental science training through hands-on experiences.
- Students use equipment and supplies they would not normally have the opportunity to use.
- NCI-Frederick has a formal partnership with the Frederick County Public School System (FCPS).
- NCI-Frederick invites all Fort Detrick partners to participate.

NCI-Frederick EOP Facts

- During the 8 year history of this program:
 - More than 13,000 elementary grade children in FCPS have participated.
 - Over 350 NCI-Frederick employees have volunteered over 8,000 hours.
 - All FCPS elementary schools have had the EOP come to their school with exception of the two newest schools.
 - Many volunteers have taken the lessons to schools in other counties and states.

EOP Lessons

- 1st Grade Solids
- 2nd Grade Interaction of Objects
- 3rd Grade Algae Study
- 4th Grade Bacteria
- 5th Grade Food Chemistry
- All of the lessons correspond with FCPS essential curriculum.

For Additional Information

Student Intern Program:

web.ncifcrf.gov/careers/student_programs/internships/sip.asp

Barbara Birnman, Program Administrator

Elementary Outreach Program: web.ncifcrf.gov/campus/outreach/eop/

Julie Hartman, Education Program Specialist

















Fort Detrick and National Interagency Confederation for Biological Research (NICBR)

USDA

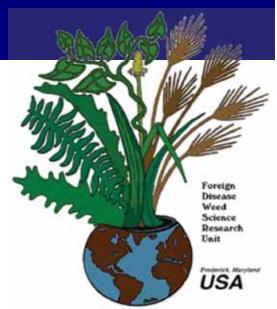
Diana Sherman





Student/Outreach Programs offered by USDA

Diana Sherman @ars.usda.gov





Programs Available

- Student Temporary Employment Program (STEP)
- Student Career Experience Program (SCEP)
- Teachers Research Fellowship Program (TRFP)
- Workforce Recruitment Program (WRP) for College Students with Disabilities
- 1890 National Scholars Program
- Hispanic Serving Institutions National Program



Student Temporary Employment Program (STEP)

This is a temporary employment program. There are no benefits, no assurance of continued employment, and no conversion to permanent. There is no income criteria to qualify.

- □ Criteria:
 - Must be a U.S. citizen.
 - Must be enrolled as a full or part time student.
 - Must be 16 years old or older.



Student Career Experience Program (SCEP)

Formerly known as the "Co-Op" program. Students receive all benefits of permanent civil service employment and their education must be related to the position's requirements. Their work schedule may be part-time, full-time or intermittent. Students may be converted to permanent position upon graduation.

□ Criteria:

- Students must be enrolled in a degree or certificate program.
- U.S. citizenship is required.
- Must be 16 years old or older.



Teachers Research Fellowship Program (TRFP)

The prime objective is to acquaint the teachers with modern Agricultural Research Service research in a hands-on laboratory setting, thus enabling them to better communicate career opportunities to their students. This is a temporary employment program.

□ Criteria:

- Must be an elementary, junior, or senior high school biological/physical science/mathematics teacher.
- Must currently be teaching and continue to teach in the fall.
- Must be a U.S. citizen (or national).



Workforce Recruitment Program (WRP) for College Students with Disabilities

Program provides a systematic evaluation of college students with disabilities for summer or permanent employment. Applications are collected by a team of interviewers visiting college campuses nationwide. Referrals are sent to locations that express an interest in considering these students. This can be a temporary or permanent employment program.

□Criteria:

- Must be a college student with a disability.
- Must be college students in disciplines as administration, business, computer science, clerical, engineering, public affairs, and science.



1890 National Scholars Program

Each year, USDA provides 34 full 4-year scholarships to students attending any of the 17 historically Black 1890 Institutions. This is a student employment program with non-competitive conversion eligibility.

- □ Criteria:
 - Open to students completing their senior year of high school, scoring a minimum of 1000 on the SAT, or a score of 21 or higher on the ACT.
 - Must maintain a 3.0 GPA or better.
 - Must major in agricultural related fields, food or natural sciences, or other allied disciplines.
 - Must submit application to 1890 USDA liaison by January 15 of each year.
 - Must be a U.S. citizen.



Hispanic Serving Institutions National Program

- Agricultural Ambassadors Program
- HACU National Internship Program
- Public Service Leaders Scholors
- USDA-HSI Fellowship Program

www.HSI.USDA.gov



For More Information

- Workforce Recruitment Program (WRP) for College Students with Disabilities http://www.usda.gov/da/employ/WRP.htm
- 1890 National Scholars Program http://1890scholars.program.usda.gov/
- Hispanic Serving Institutions National Program http://www.hsi.usda.gov/

Diana Sherman

Diana.sherman@ars.usda.gov 301-619-2878

RISING ABOVE THE GATHERING Energizing and STORM

Employing America for a Brighter Economic Future

> NATIONAL ACADEMY OF SCIENCES, NATIONAL ACADEMY OF ENGINEERING, AND INSTITUTE OF MEDICINE

> > OF THE NATIONAL ACADEMIES

COMMITTEE BIOGRAPHIC INFORMATION

NORMAN R. AUGUSTINE [NAE*] (Chair) is the retired chairman and CEO of the Lockheed Martin Corporation. He serves on the President's Council of Advisors on Science and Technology and has served as undersecretary of the Army. He is a recipient of the National Medal of Technology.

CRAIG BARRETT [NAE] is chairman of the Board of the Intel Corporation.

GAIL CASSELL [IOM*] is vice president for scientific affairs and a Distinguished Lilly Research Scholar for Infectious Diseases at Eli Lilly and Company.

STEVEN CHU [NAS*] is the director of the E.O. Lawrence Berkeley National Laboratory. He was a cowinner of the Nobel prize in physics in 1997.

ROBERT GATES is the president of Texas A&M University and served as Director of Central Intelligence.

NANCY GRASMICK is the Maryland state superintendent of schools.

CHARLES HOLLIDAY JR. [NAE] is chairman of the Board and CEO of DuPont.

SHIRLEY ANN JACKSON [NAE] is president of Rensselaer Polytechnic Institute. She is the immediate past president of the American Association for the Advancement of Science and was chairman of the US Nuclear Regulatory Commission.

ANITA K. JONES [NAE] is the Lawrence R. Quarles Professor of Engineering and Applied Science at the University of Virginia. She served as director of defense research and engineering at the US Department of Defense and was vice-chair of the National Science Board.

JOSHUA LEDERBERG [NAS/IOM] is the Sackler Foundation Scholar at Rockefeller University in New York. He was a cowinner of the Nobel prize in physiology or medicine in 1958.

RICHARD LEVIN is president of Yale University and the Frederick William Beinecke Professor of Economics.

C. D. (DAN) MOTE JR. [NAE] is president of the University of Maryland and the Glenn L. Martin Institute Professor of Engineering.

CHERRY MURRAY [NAS/NAE] is the deputy director for science and technology at Lawrence Livermore National Laboratory. She was formerly the senior vice president at Bell Labs, Lucent Technologies.

PETER O'DONNELL JR. is president of the O'Donnell Foundation of Dallas, a private foundation that develops and funds model programs designed to strengthen engineering and science education and research.

LEE R. RAYMOND [NAE] is the chairman of the Board and CEO of Exxon Mobil Corporation.

ROBERT C. RICHARDSON [NAS] is the F. R. Newman Professor of Physics and the vice provost for research at Cornell University. He was a cowinner of the Nobel prize in physics in 1996.

P. ROY VAGELOS [NAS/IOM] is the retired chairman and CEO of Merck & Co., Inc.

CHARLES M. VEST [NAE] is president emeritus of MIT and a professor of mechanical engineering. He serves on the President's Council of Advisors on Science and Technology and is the immediate past chair of the Association of American Universities.

GEORGE M. WHITESIDES [NAS/NAE] is the Woodford L. & Ann A. Flowers University Professor at Harvard University. He has served as an adviser for the National Science Foundation and the Defense Advanced Research Projects Agency.

RICHARD N. ZARE [NAS] is the Marguerite Blake Wilbur Professor of Natural Science at Stanford University. He was chair of the National Science Board from 1996 to 1998.

PRINCIPAL PROJECT STAFF

Deborah D. Stine, Study Director Tom Arrison, Innovation David Attis, Research Laurel Haak, K-12 Education Peter Henderson, Higher Education Jo Husbands, National Security

FOR MORE INFORMATION

*This report was developed under the aegis of the National Academies Committee on Science, Engineering, and Public Policy (COSEPUP), a joint committee of the three honorific academies—the National Academy of Sciences [NAS], the National Academy of Engineering [NAE], and the Institute of Medicine [IOM]. Its overall charge is to address cross-cutting issues in science and technology policy that affect the health of the national research enterprise.

More information, including the full body of the report, is available at COSEPUP's Web site, www.nationalacademies.org/cosepup.

NOTE

This report was reviewed in draft form by individuals chosen for their technical expertise, in accordance with procedures approved by the National Academies's Report Review Committee. For a list of those reviewers, refer to the full report.

EXECUTIVE SUMMARY

he United States takes deserved pride in the vitality of its economy, which forms the foundation of our high quality of life, our national security, and our hope that our children and grandchildren will inherit ever-greater opportunities. That vitality is derived in large part from the productivity of well-trained people and the steady stream of scientific and technical innovations they produce. Without high-quality, knowledge-intensive jobs and the innovative enterprises that lead to discovery and new technology, our economy will suffer and our people will face a lower standard of living. Economic studies conducted even before the information-technology revolution have shown that as much as 85% of measured growth in US income per capita was due to technological change.¹

Today, Americans are feeling the gradual and subtle effects of globalization that challenge the economic and strategic leadership that the United States has enjoyed since World War II. A substantial portion of our workforce finds itself in direct competition for jobs with lower-wage workers around the globe, and leadingedge scientific and engineering work is being accomplished in many parts of the world. Thanks to globalization, driven by modern communications and other advances, workers in virtually every sector must now face competitors who live just a mouse-click away in Ireland, Finland, China, India, or dozens of other nations whose economies are growing. This has been aptly referred to as "the Death of Distance."

CHARGE TO THE COMMITTEE

The National Academies was asked by Senator Lamar Alexander and Senator Jeff Bingaman of the Committee on Energy and Natural Resources, with endorsement by Representative Sherwood Boehlert and Representative Bart Gordon of the House Committee on Science, to respond to the following questions:

What are the top 10 actions, in priority order, that federal policymakers could take to enhance the science and technology enterprise so that the United States can successfully compete, prosper, and be secure in the global community of the 21st century? What strategy, with several concrete steps, could be used to implement each of those actions?

The National Academies created the Committee on Prospering in the Global Economy of the 21st Century to respond to this request. The charge constitutes a challenge both daunting and exhilarating: to recommend to the nation specific steps that can best strengthen the quality of life in America—our prosperity, our health, and our security. The committee has been cautious in its analysis of information. The available information is only partly adequate for the committee's needs. In addition, the time allotted to develop the report (10 weeks from the time of the committee's first gathering to report release) limited the ability of the committee to conduct an exhaustive analysis. Even if unlimited time were available, definitive analyses on many issues are not possible given the uncertainties involved.²

This report reflects the consensus views and judgment of the committee members. Although the committee consists of leaders in academe, industry, and government-including several current and former industry chief executive officers, university presidents, researchers (including three Nobel prize winners), and former presidential appointees—the array of topics and policies covered is so broad that it was not possible to assemble a committee of 20 members with direct expertise in each relevant area. Because of those limitations, the committee has relied heavily on the judgment of many experts in the study's focus groups, additional consultations via email and telephone with other experts, and an unusually large panel of reviewers. Although other solutions are undoubtedly possible, the committee believes that its recommendations, if implemented, will help the United States achieve prosperity in the 21st century.

¹For example, work by Robert Solow and Moses Abramovitz published in the middle 1950s demonstrated that as much as 85% of measured growth in US income per capita during the 1890-1950 period could not be explained by increases in the capital stock or other measurable inputs. The unexplained portion, referred to alternatively as the "residual" or "the measure of ignorance," has been widely attributed to the effects of technological change.

²Since the prepublication version of the report was released in October, certain changes have been made to correct editorial and factual errors, add relevant examples and indicators, and ensure consistency among sections of the report. Although modifications have been made to the text, the recommendations remain unchanged, except for a few corrections, which have been footnoted.

FINDINGS

Having reviewed trends in the United States and abroad, the committee is deeply concerned that the scientific and technological building blocks critical to our economic leadership are eroding at a time when many other nations are gathering strength. We strongly believe that a worldwide strengthening will benefit the world's economy-particularly in the creation of jobs in countries that are far less well-off than the United States. But we are worried about the future prosperity of the United States. Although many people assume that the United States will always be a world leader in science and technology, this may not continue to be the case inasmuch as great minds and ideas exist throughout the world. We fear the abruptness with which a lead in science and technology can be lost—and the difficulty of recovering a lead once lost, if indeed it can be regained at all.

The committee found that multinational companies use criteria³ such as the following in determining where to locate their facilities and the jobs that result:

- Cost of labor (professional and general workforce).
- Availability and cost of capital.
- Availability and quality of research and innovation talent.
- Availability of qualified workforce.
- Taxation environment.
- Indirect costs (litigation, employee benefits such as healthcare, pensions, vacations).
- Quality of research universities.
- Convenience of transportation and communication (including language).
- Fraction of national research and development supported by government.
- Legal-judicial system (business integrity, property rights, contract sanctity, patent protection).
- Current and potential growth of domestic market.
- Attractiveness as place to live for employees.
- Effectiveness of national economic system.

³D.H. Dalton, M.G. Serapio, Jr., P.G. Yoshida. 1999. Globalizing Industrial Research and Development. US Department of Commerce, Technology Administration, Office of Technology Policy. Grant Gross. 2003, October 9. "CEOs defend moving jobs offshore at tech summit." InfoWorld. Mehlman, Bruce. 2003. Offshore Outsourcing and the Future of American Competitiveness. "High tech in China: is it a threat to Silicon Valley?" 2002, October 28. Business Week online. B. Callan, S. Costigan, K. Keller. 1997. Exporting U.S. High Tech: Facts and Fiction about the Globalization of Industrial R&D, Council on Foreign Relations, New York, NY.

Although the US economy is doing well today, current trends in each of these areas indicate that the United States may not fare as well in the future without government intervention. This nation must prepare with great urgency to preserve its strategic and economic security. Because other nations have, and probably will continue to have, the competitive advantage of a low wage structure, the United States must compete by optimizing its knowledge-based resources, particularly in science and technology, and by sustaining the most fertile environment for new and revitalized industries and the well-paying jobs they bring. We have already seen that capital, factories, and laboratories readily move wherever they are thought to have the greatest promise of return to investors.

RECOMMENDATIONS

The committee reviewed hundreds of detailed suggestions—including various calls for novel and untested mechanisms—from other committees, from its focus groups, and from its own members. The challenge is immense, and the actions needed to respond are immense as well.

The committee identified two key challenges that are tightly coupled to scientific and engineering prowess: creating high-quality jobs for Americans, and responding to the nation's need for clean, affordable, and reliable energy. To address those challenges, the committee structured its ideas according to four basic recommendations that focus on the human, financial, and knowledge capital necessary for US prosperity.

The four recommendations focus on actions in K–12 education (10,000 Teachers, 10 Million Minds), research (Sowing the Seeds), higher education (Best and Brightest), and economic policy (Incentives for Innovation) that are set forth in the following sections. Also provided are a total of 20 implementation steps for reaching the goals set forth in the recommendations.

Some actions involve changes in the law. Others require financial support that would come from reallocation of existing funds or, if necessary, from new funds. Overall, the committee believes that the investments are modest relative to the magnitude of the return the nation can expect in the creation of new high-quality jobs and in responding to its energy needs.

The committee notes that the nation is unlikely to receive some sudden "wake-up" call; rather, the problem is one that is likely to evidence itself gradually over a surprisingly short period.

IO,OOO TEACHERS, IO MILLION MINDS, AND K-12 SCIENCE AND MATHEMATICS EDUCATION

RECOMMENDATION A: Increase America's talent pool by vastly improving K–12 science and mathematics education.

Implementation Actions

The highest priority should be assigned to the following actions and programs. All should be subjected to continuing evaluation and refinement as they are implemented.

Action A-1: Annually recruit 10,000 science and mathematics teachers by awarding 4-year scholarships and thereby educating 10 million minds. Attract 10,000 of America's brightest students to the teaching profession every year, each of whom can have an impact on 1,000 students over the course of their careers. The program would award competitive 4-year scholarships for students to obtain bachelor's degrees in the physical or life sciences, engineering, or mathematics with concurrent certification as K-12 science and mathematics teachers. The merit-based scholarships would provide up to \$20,000 a year for 4 years for qualified educational expenses, including tuition and fees, and require a commitment to 5 years of service in public K-12 schools. A \$10,000 annual bonus would go to participating teachers in underserved schools in inner cities and rural areas. To provide the highest-quality education for undergraduates who want to become teachers, it would be important to award matching grants, on a one-to-one basis, of \$1 million a year for up to 5 years, to as many as 100 universities and colleges to encourage them to establish integrated 4-year undergraduate programs leading to bachelor's degrees in the physical and life sciences, mathematics, computer sciences, or engineering with teacher certification. The models for this action are UTeach at the University of Texas and California Teach at the University of California.

Action A-2: Strengthen the skills of 250,000 teachers through training and education programs at summer institutes, in master's programs, and in Advanced Placement (AP) and International Baccalaureate (IB) training programs. Use proven models to strengthen the skills (and compensation, which is based on education and skill level) of 250,000 *current* K–12 teachers.

- Summer institutes: Provide matching grants to state and regional 1- to 2-week summer institutes to upgrade the skills and state-of-the-art knowledge of as many as 50,000 practicing teachers each summer. The material covered would allow teachers to keep current with recent developments in science, mathematics, and technology and allow for the exchange of best teaching practices. The Merck Institute for Science Education is one model for this action.
- Science and mathematics master's programs: Provide grants to research universities to offer, over 5 years, 50,000 current middle school and high school science, mathematics, and technology teachers (with or without undergraduate science, mathematics, or engineering degrees) 2-year, part-time master's degree programs that focus on rigorous science and mathematics content and pedagogy. The model for this action is the University of Pennsylvania Science Teachers Institute.
- AP, IB, and pre-AP or pre-IB training: Train an additional 70,000 AP or IB and 80,000 pre-AP or pre-IB instructors to teach advanced courses in science and mathematics. Assuming satisfactory performance, teachers may receive incentive payments of \$1,800 per year, as well as \$100 for each student who passes an AP or IB exam in mathematics or science. There are two models for this program: the Advanced Placement Incentive Program and Laying the Foundation, a pre-AP program.
- K–12 curriculum materials modeled on a world-class standard: Foster high-quality teaching with world-class curricula, standards, and assessments of student learning. Convene a national panel to collect, evaluate, and develop rigorous K–12 materials that would be available free of charge as a *voluntary* national curriculum. The model for this action is the Project Lead the Way pre-engineering courseware.

Action A-3: Enlarge the pipeline of students who are prepared to enter college and graduate with a degree in science, engineering, or mathematics by increasing the number of students who pass AP and IB science and mathematics courses. Create opportunities and incentives for middle school and high school students to pursue advanced work in science and mathematics. By 2010, increase the number of students who take at least one AP or IB mathematics or science exam to 1.5 million, and set a goal of tripling the number who pass those tests to 700,000.⁴ Student incentives for success would include 50% examination fee rebates and \$100 minischolarships for each passing score on an AP or IB science or mathematics examination.

Although not included among its implementation actions, the committee also finds attractive the expansion of two approaches to improving K–12 science and mathematics education that are already in use:

- Statewide specialty high schools: Specialty secondary education can foster leaders in science, technology, and mathematics. Specialty schools immerse students in high-quality science, technology, and mathematics education; serve as a mechanism to test teaching materials; provide a training ground for K–12 teachers; and provide the resources and staff for summer programs that introduce students to science and mathematics.
- *Inquiry-based learning:* Summer internships and research opportunities provide especially valuable laboratory experience for both middle school and high school students.

SOWING THE SEEDS, THROUGH SCIENCE AND ENGINEERING RESEARCH

RECOMMENDATION B: Sustain and strengthen the nation's traditional commitment to long-term basic research that has the potential to be transformational to maintain the flow of new ideas that fuel the economy, provide security, and enhance the quality of life.

Implementation Actions

Action B-1: Increase the federal investment in longterm basic research by 10% each year over the next 7 years through reallocation of existing funds⁵ or, if necessary, through the investment of new funds. Special attention should go to the physical sciences, engineering, mathematics, and information sciences and to Department of Defense (DoD) basic-research funding. This special attention does not mean that there should be a disinvestment in such important fields as the life sciences or the social sciences. A balanced research portfolio in all fields of science and engineering research is critical to US prosperity. Increasingly, the most significant new scientific and engineering advances are formed to cut across several disciplines. This investment should be evaluated regularly to realign the research portfolio to satisfy emerging needs and promises—unsuccessful projects and venues of research should be replaced with research projects and venues that have greater potential.

Action B-2: Provide new research grants of \$500,000 each annually, payable over 5 years, to 200 of the nation's most outstanding early-career researchers. The grants would be made through existing federal research agencies—the National Institutes of Health (NIH), the National Science Foundation (NSF), the Department of Energy (DoE), DoD, and the National Aeronautics and Space Administration (NASA)—to underwrite new research opportunities at universities and government laboratories.

⁴This sentence was incorrectly phrased in the original October 12, 2005 edition of the Executive Summary and has now been corrected.

⁵The funds may come from anywhere in government, not just other research funds

Action B-3: Institute a National Coordination Office for Advanced Research Instrumentation and Facilities to manage a fund of \$500 million in incremental funds per year over the next 5 years—through reallocation of existing funds or, if necessary, through the investment of new funds—to ensure that universities and government laboratories create and maintain the facilities, instrumentation, and equipment needed for leading-edge scientific discovery and technological development. Universities and national laboratories would compete annually for these funds.

Action B-4: Allocate at least 8% of the budgets of federal research agencies to discretionary funding that would be managed by technical program managers in the agencies and be focused on catalyzing high-risk, high-payoff research of the type that often suffers in today's increasingly risk-averse environment.

Action B-5: Create in the Department of Energy an organization like the Defense Advanced Research Projects Agency (DARPA) called the Advanced Research Projects Agency-Energy (ARPA-E).6 The director of ARPA-E would report to the under secretary for science and would be charged with sponsoring specific research and development programs to meet the nation's long-term energy challenges. The new agency would support creative "out-of-the-box" transformational generic energy research that industry by itself cannot or will not support and in which risk may be high but success would provide dramatic benefits for the nation. This would accelerate the process by which knowledge obtained through research is transformed to create jobs and address environmental, energy, and security issues. ARPA-E would be based on the historically successful DARPA model and would be designed as a lean and agile organization with a great deal of independence that can start and stop targeted programs on the basis of performance and do so in a timely manner. The agency would itself perform no research or transitional effort but would fund such work conducted by universities, startups, established firms, and others. Its staff would turn over approximately every 4 years. Although the

agency would be focused on specific energy issues, it is expected that its work (like that of DARPA or NIH) will have important spinoff benefits, including aiding in the education of the next generation of researchers. Funding for ARPA-E would start at \$300 million the first year and increase to \$1 billion per year over 5-6 years, at which point the program's effectiveness would be evaluated and any appropriate actions taken.

Action B-6: Institute a Presidential Innovation Award to stimulate scientific and engineering advances in the national interest. Existing presidential awards recognize lifetime achievements or promising young scholars, but the proposed new awards would identify and recognize persons who develop unique scientific and engineering innovations in the national interest at the time they occur.

⁶One committee member, Lee Raymond, does not support this action item. He does not believe that ARPA-E is necessary as energy research is already well funded by the federal government, along with formidable funding of energy research by the private sector. Also, ARPA-E would, in his view, put the federal government in the business of picking "winning energy technologies"—a role best left to the private sector.

BEST AND BRIGHTEST IN SCIENCE AND ENGINEERING HIGHER EDUCATION

RECOMMENDATION C: Make the United States the most attractive setting in which to study and perform research so that we can develop, recruit, and retain the best and brightest students, scientists, and engineers from within the United States and throughout the world.

Implementation Actions

Action C-1: Increase the number and proportion of US citizens who earn bachelor's degree in the physical sciences, the life sciences, engineering, and mathematics by providing 25,000 new 4-year competitive undergraduate scholarships each year to US citizens attending US institutions. The Undergraduate Scholar Awards in Science, Technology, Engineering, and Mathematics (USA-STEM) would be distributed to states on the basis of the size of their congressional delegations and awarded on the basis of national examinations. An award would provide up to \$20,000 annually for tuition and fees.

Action C-2: Increase the number of US citizens pursuing graduate study in "areas of national need" by funding 5,000 new graduate fellowships each year. NSF should administer the program and draw on the advice of other federal research agencies to define national needs. The focus on national needs is important both to ensure an adequate supply of doctoral scientists and engineers and to ensure that there are appropriate employment opportunities for students once they receive their degrees. Portable fellowships would provide a stipend of \$30,0007 annually directly to students, who would choose where to pursue graduate studies instead of being required to follow faculty research grants, and up to \$20,000 annually for tuition and fees.

Action C-3: Provide a federal tax credit to encourage employers to make continuing education available (either internally or though colleges and universities) to practicing scientists and engineers. These incentives would promote career-long learning to keep the workforce productive in an environment of rapidly evolving scientific and engineering discoveries and technological advances and would allow for retraining to meet new demands of the job market.

Action C-4: Continue to improve visa processing for international students and scholars to provide less complex procedures and continue to make improvements on such issues as visa categories and duration, travel for scientific meetings, the technology alert list, reciprocity agreements, and changes in status.

Action C-5: Provide a 1-year automatic visa extension to international students who receive doctorates or the equivalent in science, technology, engineering, mathematics, or other fields of national need at qualified US institutions to remain in the United States to seek employment. If these students are offered jobs by US-based employers and pass a security screening test, they should be provided automatic work permits and expedited residence status. If students are unable to obtain employment within 1 year, their visas would expire.

Action C-6: Institute a new skills-based, preferential immigration option. Doctoral-level education and science and engineering skills would substantially raise an applicant's chances and priority in obtaining US citizenship. In the interim, the number of H-1B visas should be increase by 10,000, and the additional visas should be available for industry to hire science and engineering applicants with doctorates from US universities.⁸

⁷An incorrect number was provided for the graduate student stipend in the original October 12, 2005 edition of the Executive Summary and has now been corrected.

⁸Since the report was released, the committee has learned that the Consolidated Appropriations Act of 2005, signed into law on December 8, 2004, exempts individuals that have received a master's or higher education degree from a US university from the statutory cap (up to 20,000). The bill also raised the H-1B fee and allocated funds to train American workers. The committee believes that this provision is sufficient to respond to its recommendation—even though the 10,000 additional visas recommended is specifically for science and engineering doctoral candidates from US universities, which is a narrower subgroup.

Action C-7: Reform the current system of "deemed exports". The new system should provide international students and researchers engaged in fundamental research in the United States with access to information and research equipment in US industrial, academic, and national laboratories comparable with the access provided to US citizens and permanent residents in a similar status. It would, of course, exclude information and facilities restricted under national-security regulations. In addition, the effect of deemed-exports9 regulations on the education and fundamental research work of international students and scholars should be limited by removing from the deemed-exports technology list all technology items (information and equipment) that are available for purchase on the overseas open market from foreign or US companies or that have manuals that are available in the public domain, in libraries, over the Internet, or from manufacturers.

INCENTIVES FOR INNOVATION

Recommendation D: Ensure that the United States is the premier place in the world to innovate; invest in downstream activities such as manufacturing and marketing; and create high-paying jobs based on innovation by such actions as modernizing the patent system, realigning tax policies to encourage innovation, and ensuring affordable broadband access.

Implementation Actions

Action D-1: Enhance intellectual-property protection for the 21st-century global economy to ensure that systems for protecting patents and other forms of intellectual property underlie the emerging knowledge economy but allow research to enhance innovation. The patent system requires reform of four specific kinds:

- Provide the US Patent and Trademark Office with sufficient resources to make intellectual-property protection more timely, predictable, and effective.
- Reconfigure the US patent system by switching to a "first-inventor-to-file" system and by instituting administrative review *after* a patent is granted. Those reforms would bring the US system into alignment with patent systems in Europe and Japan.
- Shield research uses of patented inventions from infringement liability. One recent court decision could jeopardize the long-assumed ability of academic researchers to use patented inventions for research.
- Change intellectual-property laws that act as barriers to innovation in specific industries, such as those related to data exclusivity (in pharmaceuticals) and those that increase the volume and unpredictability of litigation (especially in information-technology industries).

Action D-2: Enact a stronger research and development tax credit to encourage private investment in innovation. The current Research and Experimentation Tax Credit goes to companies that *increase* their research and development spending above a base amount calculated from their spending in prior years. Congress and the

[&]quot;The controls governed by the Export Administration Act and its implementing regulations extend to the transfer of technology. Technology includes "specific information necessary for the 'development,' 'production,' or 'use' of a product". Providing information that is subject to export controls—for example, about some kinds of computer hardware—to a foreign national within the United States may be "deemed" an export, and that transfer requires an export license. The primary responsibility for administering controls on deemed exports lies with the Department of Commerce, but other agencies have regulatory authority as well.

Administration should make the credit permanent, ¹⁰ and it should be increased from 20% to 40% of the qualifying increase so that the US tax credit is competitive with those of other countries. The credit should be extended to companies that have consistently spent large amounts on research and development so that they will not be subject to the current *de facto* penalties for having previously invested in research and development.

Action D-3: Provide tax incentives for US-based innovation. Many policies and programs affect innovation and the nation's ability to profit from it. It was not possible for the committee to conduct an exhaustive examination, but alternatives to current economic policies should be examined and, if deemed beneficial to the United States, pursued. These alternatives could include changes in overall corporate tax rates and special tax provisions providing the purchase of high-technology research and manufacturing equipment, treatment of capital gains, and incentives for long-term investments in innovation. The Council of Economic Advisers and the Congressional Budget Office should conduct a comprehensive analysis to examine how the United States compares with other nations as a location for innovation and related activities with a view to ensuring that the United States is one of the most attractive places in the world for long-term innovation-related investment and the jobs resulting from that investment. From a tax standpoint, that is not now the case.

Action D-4: Ensure ubiquitous broadband Internet access. Several nations are well ahead of the United States in providing broadband access for home, school, and business. That capability can be expected to do as much to drive innovation, the economy, and job creation in the 21st century as did access to the telephone, interstate highways, and air travel in the 20th century. Congress and the Administration should take action—mainly in the regulatory arena and in spectrum management—to ensure widespread affordable broadband access in the very near future.

CONCLUSION

The committee believes that its recommendations and the actions proposed to implement them merit serious consideration if we are to ensure that our nation continues to enjoy the jobs, security, and high standard of living that this and previous generations worked so hard to create. Although the committee was asked only to recommend actions that can be taken by the federal government, it is clear that related actions at the state and local levels are equally important for US prosperity, as are actions taken by each American family. The United States faces an enormous challenge because of the disparity it faces in labor costs. Science and technology provide the opportunity to overcome that disparity by creating scientists and engineers with the ability to create entire new industries—much as has been done in the past.

It is easy to be complacent about US competitiveness and preeminence in science and technology. We have led the world for decades, and we continue to do so in many research fields today. But the world is changing rapidly, and our advantages are no longer unique. Some will argue that this is a problem for market forces to resolve—but that is exactly the concern. Market forces are *already at work* moving jobs to countries with less costly, often better educated, highly motivated work forces and more friendly tax policies.

Without a renewed effort to bolster the foundations of our competitiveness, we can expect to lose our privileged position. For the first time in generations, the nation's children could face poorer prospects than their parents and grandparents did. We owe our current prosperity, security, and good health to the investments of past generations, and we are obliged to renew those commitments in education, research, and innovation policies to ensure that the American people continue to benefit from the remarkable opportunities provided by the rapid development of the global economy and its not inconsiderable underpinning in science and technology.

¹⁰The previous R&D tax credit expired in December 2005.

SOME COMPETITIVENESS INDICATORS

US ECONOMY

- The United States is today a net importer of high-technology products. Its trade balance in high-technology manufactured goods shifted from plus \$54 billion in 1990 to negative \$50 billion in 2001.¹
- In one recent period, low-wage employers, such as Wal-Mart (now the nation's largest employer) and McDonald's, created 44% of the new jobs while high-wage employers created only 29% of the new jobs.²
- The United States is one of the few countries in which industry plays a major role in providing health care for its employees and their families. Starbucks spends more on healthcare than on coffee. General Motors spends more on health care than on steel.³
- US scheduled airlines currently outsource portions of their aircraft maintenance to China and El Salvador.⁴
- IBM recently sold its personal computer business to an entity in China.⁵
- Ford and General Motors both have junk bond ratings.⁶
- It has been estimated that within a decade nearly 80% of the world's middle-income consumers would live in nations outside the currently industrialized world. China alone could have 595 million middle-income consumers and 82 million uppermiddle-income consumers. The total population of the United States is currently 300 million and is projected to be 315 million in a decade.⁷
- Some economists estimate that about half of US economic growth since World War II has been the result of technological innovation.⁸
- In 2005, American investors put more new money in foreign stock funds than in domestic stock portfolios.⁹

COMPARATIVE ECONOMICS

- Chemical companies closed 70 facilities in the United States in 2004 and tagged 40 more for shutdown. Of 120 chemical plants being built around the world with price tags of \$1 billion or more, one is in the United States and 50 are in China. No new refineries have been built in the United States since 1976.¹⁰
- The United States is said to have 7 million illegal immigrants,¹¹ but under the law the number of visas set aside for "highly qualified foreign workers," many of whom contribute significantly to the nation's innovations, dropped to 65,000 a year from its 195,000 peak.¹²
- When asked in Spring 2005 what is the most attractive place in the world in which to "lead a good life", respondents in only one (India) of the 16 countries polled indicated the United States.¹³
- A company can hire nine factory workers in Mexico for the cost of one in America. A company can hire eight young professional engineers in India for the cost of one in America.¹⁴
- The share of leading-edge semiconductor manufacturing capacity owned or partly owned by US companies today is half what it was as recently as 2001.¹⁵
- During 2004, China overtook the United States to become the leading exporter of informationtechnology products, according to the OECD.¹⁶
- The United States ranks only 12th among OECD countries in the number of broadband connections per 100 inhabitants.¹⁷

K-12 EDUCATION

- Fewer than one-third of US 4th-grade and 8th-grade students performed at or above a level called "proficient" in mathematics; "proficiency" was considered the ability to exhibit competence with challenging subject matter. Alarmingly, about one-third of the 4th graders and one-fifth of the 8th graders lacked the competence to perform even basic mathematical computations. 18
- In 1999, 68% of US 8th grade students received instruction from a mathematics teacher who did not hold a degree or certification in mathematics.¹⁹
- In 2000, 93% of students in grades 5-9 were taught physical science by a teacher lacking a major or certification in the physical sciences (chemistry, geology, general science, or physics).²⁰
- In 1995 (the most recent data available), US 12th graders performed below the international average for 21 countries on a test of general knowledge in mathematics and science.²¹
- US 15-year-olds ranked 24th out of 40 countries that participated in a 2003 administration of the Program for International Student Assessment (PISA) examination, which assessed students' ability to apply mathematical concepts to realworld problems.²²
- According to a recent survey, 86% of US voters believe that the United States must increase the number of workers with a background in science and mathematics or America's ability to compete in the global economy will be diminished.²³
- American youth spend more time watching television²⁴ than in school.²⁵
- Because the United States does not have a set of national curricula, changing K-12 education is challenging, given that there are almost 15,000 school systems in the United States and the average district has only about 6 schools.²⁶

HIGHER EDUCATION

- In South Korea, 38% of all undergraduates receive their degrees in natural science or engineering. In France, the figure is 47%, in China, 50%, and in Singapore 67%. In the United States, the corresponding figure is 15%.²⁷
- Some 34% percent of doctoral degrees in natural sciences (including the physical, biological, earth, ocean, and atmospheric sciences) and 56% of engineering PhDs in the United States are awarded to foreign-born students.²⁸
- In the US science and technology workforce in 2000, 38% of PhDs were foreign-born.
- Estimates of the number of engineers, computer scientists, and information technology students who obtain 2-, 3-, or 4-year degrees vary. One estimate is that in 2004, China graduated about 350,000 engineers, computer scientists, and information technologists with 4-year degrees, while the United States graduated about 140,000. China also graduated about 290,000 with 3-year degrees in these same fields, while the United States graduated about 85,000 with 2- or 3-year degrees.30 Over the past 3 years alone, both China³¹ and India³² have doubled their production of 3- and 4-year degrees in these fields, while the US³³ production of engineers is stagnant and the rate of production of computer scientists and information technologists doubled.
- About one-third of US students intending to major in engineering switch majors before graduating.³⁴
- There were almost twice as many US physics bachelor's degrees awarded as in 1956, the last graduating class before Sputnik than in 2004.³⁵
- More S&P 500 CEOs obtained their undergraduate degrees in engineering than in any other field.³⁶

RESEARCH

- In 2001 (the most recent year for which data are available), US industry spent more on tort litigation than on research and development.³⁷
- In 2005, only four American companies ranked among the top 10 corporate recipients of patents granted by the *United States* Patent and Trademark Office.³⁸
- Beginning in 2007, the most capable high-energy particle accelerator on Earth will, for the first time, reside outside the United States.³⁹
- Federal funding of research in the physical sciences, as a percentage of GDP, was 45% less in FY 2004 than in FY 1976.⁴⁰ The amount invested annually by the US federal government in research in the physical sciences, mathematics, and engineering combined equals the annual increase in US health care costs incurred every 20 days.⁴¹

PERSPECTIVES

- "We go where the smart people are. Now our business operations are two-thirds in the U.S. and one-third overseas. But that ratio will flip over the next 10 years." –Intel spokesman Howard High⁴²
- "If we don't step up to the challenge of finding and supporting the best teachers, we'll undermine everything else we are trying to do to improve our schools."—Louis V. Gerstner, Jr., Former Chairman, IBM⁴³
- "If you want good manufacturing jobs, one thing you could do is graduate more engineers. We had more sports exercise majors graduate than electrical engineering grads last year." — Jeffrey R. Immelt, Chairman and Chief Executive Office, General Electric⁴⁴
- "If I take the revenue in January and look again in December of that year 90% of my December revenue comes from products which were not there in January." – Craig Barrett, Chairman of the Intel Corporation⁴⁵
- "When I compare our high schools to what I see when I'm traveling abroad, I am terrified for our workforce of tomorrow." –Bill Gates, Chairman and Chief Software Architect of Microsoft Corporation⁴⁶
- "Where once nations measured their strength by the size of their armies and arsenals, in the world of the future knowledge will matter most."
 President Bill Clinton 47
- "Science and technology have never been more essential to the defense of the nation and the health of our economy."—President George W. Bush⁴⁸

NOTES for SOME COMPETITIVENESS INDICATORS and PERSPECTIVES:

For 2001, the dollar value of high-technology imports was \$561 billion; the value of high-technology exports was \$511 billion. See National Science Board. 2004. Science and Engineering Indicators 2004 (NSB 04-01). Arlington, VA. National Science Foundation. Appendix Table 6-01. Page A6-5 provides the export numbers for 1990 and 2001 and page A6-6 has the import numbers.

²Steve Roach. More Jobs, Worse Work. New York Times. July 22, 2004.

³Chris Noon. 2005. "Starbuck's Schultz Bemoans Health Care Costs." Forbes. com, September 19.Available at:http://www.forbes.com/facesinthenews/2005/09/15/starbuckshealthcarebenefitscx_cn_0915autofacescan01.html? partner=yahooti; Ron Scherer. 2005. "Rising Benefits Burden." Christian Science Monitor, June 9. Available at: http://www.csmonitor.com/2005/0609/p01s01-usec.html.

⁴Sara Kehaulani Goo. Airlines Outsource Upkeep. Washington Post. August 21, 2005. Available at: http://www.washingtonpost.com/wp-dyn/content/article/2005/08/20/AR2005082000979.html. Sara Kehaulani Goo. Two-Way Traffic in Airplane Repair. Washington Post, June 1, 2004. Available at http://www.washingtonpost.com/wp-dyn/articles/A5138-2004 May31.html.

⁵Michael Kanellos. 2004. "IBM Sells PC Group to Lenovo." News.com. December 8. Available at: http://news.com.com/IBM+sells+PC+group+to+Lenovo/2100-1042_3-5482284.html.

⁶http://www.nytimes.com/2005/05/05/business/05cnd-auto.html?ex= 1137128400 &en=ac63687768634c6d&ei=5070.

For China, see Paul A. Laudicina, 2005. World Out of Balance: Navigating Global Risks to Seize Competitive Advantage. New York: McGraw Hill, p. 76. For the United States, see US Census Bureau. US. Population Clock. Available at www.census.gov for current population and for the projected population, see Population Projections Program, Population Division, U.S. Census Bureau. Population Projections of the United States by Age, Sex, Race, Hispanic Origin, and Nativity: 1999 to 2100. Washington, D.C. January 13, 2000. Available at: http://www.census.gov/population/www/projections/natsum-T3.html.

⁸Michael J. Boskin and Lawrence J. Lau. 1992. Capital, Technology, and Economic Growth. In Nathan Rosenberg, Ralph Landau, and David C. Mowery, eds. Technology and the Wealth of Nations: Stanford University Press: Stanford, CA.

⁹Paul J. Lim. Looking Ahead Means Looking Abroad. New York Times. January 8th 2006.

¹⁰Michael Arndt. 2005. "No Longer the Lab of the World: U.S. Chemical Plants are Closing in Droves as Production Heads Abroad." BusinessWeek, May 2. Available at: http://www.businessweek.com/magazine/content/05_18/b3931106.htm and http://www.usnews.com/usnews/biztech/articles/051010/10energy.htm.

¹¹As of 2000, the unauthorized resident population in the United States was 7 million. See US Citizenship and Immigration Services. 2003. "Executive Summary: Estimates of the Unauthorized Immigrant Population Residing in the United States: 1990 to 2000." January 31. Available at: http://uscis.gov/graphics/shared/statistics/publications/2000ExecSumm.pdf.

¹²Section 214(g) of the Immigration and Nationality Act (Act) sets an annual limit on the number of aliens that can receive H-1B status in a fiscal year. For FY2000 the limit was set at 115,000. The American Competitiveness in the Twenty-First Century Act increased the annual limit to 195,000 for 2001, 2002, and 2003. After that date the cap reverts back to 65,000. H-1B visas allow employers to have access to highly educated foreign professionals who have experience in specialized fields and who have at least a bachelor's degree or the equivalent. The cap does not apply to educational institutions. In November 2004, Congress created an exemption for 20,000 foreign nationals earning advanced degrees from US universities. See Immigration and Nationality Act Section 101(a)(15)(h)(1)(b). See US Citizenship and Immigration Services. 2005. "Public Notice: "USCIS Announces Update Regarding New H-1B Exemptions" July 12. Available at:

http://uscis.gov/graphics/publicaffairs/newsrels/H1B_06Cap_011806PR.pdf. and US Citizenship and Immigration Services. 2000. "Questions and Answers: Changes to the H-1B Program" November 21. Available at: http://uscis.gov/graphics/publicaffairs/questsans/H1BChang.htm.

¹³Pew Research Center. 2005 "U.S. Image Up Slightly, But Still Negative, American Character Gets Mixed Reviews" Pew Global Attitudes Project. Washington, DC. Available at: http://pewglobal.org/reports/display.php? ReportID=247 The interview asked nearly 17,000 people the question: "Suppose a young person who wanted to leave this country asked you to recommend where to go to lead a good life–what country would you recommend?" Except for respondents in India, Poland, and Canada, no more than one-tenth of the people in the other nations said they would recommend the United States. Canada and Australia won the popularity contest.

¹⁴United States Bureau of Labor Statistics. 2005. International Comparisons of Hourly Compensation Costs for Production Workers in Manufacturing, 2004. November 18. Available at: ftp://ftp.bls.gov/pub/news.release/History/ichcc.11182005.news.

¹⁵Semiconductor Industry Association. 2005. "Choosing to Compete." December 12. Available at: http://www.sia-online.org/downloads/FAD% 20′05%20-%20Scalise%20Presentation.pdf.

¹⁶OECD. 2005. "China Overtakes U.S. As World's Leading Exporter of Information Technology Goods." December 12. Available at: http://www.oecd.org/document/60/0,2340,en_2649_201185_35834236_1_1_1_1,00.html. The main categories included in OECD's definition of ICT (information and communications technology) goods are electronic components, computers and related equipment, audio and video equipment, and telecommunication equipment.

¹⁷OECD. 2005. "OECD Broadband Statistics, June 2005." October 20. Available at: http://www.oecd.org/document/16/0,2340,en_2649_201185_35526608_1_1_1_1,00.html#data2004.

¹⁸National Center for Education Statistics. 2006. "The Nation's Report Card: Mathematics 2005." See http://nces.ed.gov/nationsreportcard/pdf/main2005/2006453.pdf.

¹⁹National Science Board. 2004. Science and Engineering Indicators 2004 (NSB 04-01). Arlington, VA: National Science Foundation. Chapter 1.

²⁰National Center for Education Statistics. 2004. Schools and Staffing Survey, "Qualifications of the Public School Teacher Workforce: Prevalence of Out-of-Field Teaching 1987-88 to 1999-2000 (Revised)," p. 10. See http://nces.ed.gov/pubs2002/2002603.pdf.

²¹National Center for Education Statistics. 1999. Highlights from TIMSS http://nces.ed.gov/pubs99/1999081.pdf.

²²National Center for Education Statistics.2005. "International Outcomes of Learning in Mathematics Literacy and Problem Solving: PISA 2003 Results from the U.S. Perspective," pp. 15 and 29. See http://nces.ed.gov/pubs2005/2005003.pdf.

²³The Business Roundtable. 2006. "Innovation and U.S. Competitiveness: Addressing the Talent Gap. Public Opinion Research." January 12. Available at: http://www.businessroundtable.org/pdf/20060112Two-pager.pdf.

²⁴American Academy of Pediatrics. "Television—How it Affects Children." Available at http://www.aap.org/pubed/ZZZGF8VOQ7C.htm?&sub_cat=1. The American Academy of Pediatrics reports that "Children in the United States watch about 4 hours of TV every day"; this works out to be 1460 hours per year.

²⁵National Center for Education Statistics. 2005. The Condition of Education. Table 26-2 Average Number of Instructional Hours Per Year Spent in Public School, By Age or Grade of Student and Country: 2000 and 2001. Available at http://nces.ed.gov/programs/coe/2005/section4/table.asp? tableID=284. NCES reports that in 2000 US 15-year-olds spent 990 hours in school, during the same year 4th graders spent 1040 hours.

²⁶National Center for Education Statistic (2006), "Public Elementary and Secondary Students, Staff, Schools, and School Districts: School Year 2003–04". See http://nces.ed.gov/pubs2006/2006307.pdf.

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²⁷Analysis conducted by the Association of American Universities. 2006. National Defense Education and Innovation Initiative. Based on data in National Science Board. 2004. Science and Engineering Indicators 2004 (NSB 04-01). Arlington, VA: National Science Foundation. Appendix Table 2-33. For countries with both short and long degrees, the ratios are calculated with both short and long degrees as the numerator.

 $^{28}\mbox{National Science Board.}$ 2004. Science and Engineering Indicators 2004 (NSB 04-01). Arlington, VA: National Science Foundation. Chapter 2, Figure 2-23.

²⁹National Science Board. 2004. Science and Engineering Indicators 2004 (NSB 04-01). Arlington, VA: National Science Foundation.

³⁰G. Gereffi and V. Wadhwa. 2005. Framing the Engineering Outsourcing Debate: Placing the United States on a Level Playing Field with China and India. http://memp.pratt.duke.edu/downloads/duke_outsourcing_2005.pdf.

³¹Ministry of Science and Technology (MOST). 2004. Chinese Statistical Yearbook 2004. People's Republic of China, Chapter 21, Table 21-11. Available at http://www.stats.gov.cn/english/statisticaldata/yearlydata/yb2004-e/indexeh.htm. The extent to which engineering degrees from China are comparable to those from the United States is uncertain.

³²National Association of Software and Service Companies. 2005. Strategic Review 2005., India. Chapter 6. Sustaining the India Advantage. Available at http://www.nasscom.org/strategic2005.asp.

³³National Center for Education Statistics. 2004. Digest of Education Statistics 2004. Institute of Education Sciences, Department of Education, Washington DC, Table 250. Available at http://nces.ed.gov/programs/digest/d04/tables/dt04_250.asp.

³⁴Myles Boylan. 2004. Assessing Changes in Student Interest in Engineering Careers Over the Last Decade. CASEE, National Academy of Engineering. Available at http://www.nae.edu/NAE/caseecomnew.nsf/ weblinks/NFOY-6GHJ7B/\$file/Engineering%20Interest%20-%20HS%20through%20 College_V21.pdf; Clifford Adelman. 1998. Women and Men on the Engineering Path: A Model for Analysis of Undergraduate Careers. Washington DC: US Department of Education. http://www.nae.edu/nae/diversitycom.nsf/98b72da8aad70f1785256da20053deaf/85256cfb004 84b5c85256da000002f83/\$FILE/Adelman_Women_and_Men_of_the_Engineering_Path.pdf). According to this Department of Education analysis, the majority of students who switch from engineering majors complete a major in business or other non-science and engineering fields.

³⁵National Center for Education Statistics Digest of Education Statistics. The American Institute of Physics Statistical Research Center.

³⁶Spencer Stuart. 2005. "2004 CEO Study: A Statistical Snapshot of Leading CEOs." Available at: http://content.spencerstuart.com/sswebsite/pdf/lib/Statistical_Snapshot_of_Leading_CEOs_relB3.pdf#search='ceo%20 educational%20background'.

³⁷US research and development spending in 2001 was \$273.6 billion, of which industry performed \$194 billion and funded about \$184 billion. National Science Board. 2004. Science and Engineering Indicators 2004 (NSB 04-01). Arlington, VA: National Science Foundation. One estimate of tort litigation costs in the United States was \$205 billion in 2001. Jeremey A. Leonard. 2003. "How Structural Costs Imposed on U.S. Manufacturers Harm Workers and Threaten Competitiveness." Prepared for the Manufacturing Institute of the National Association of Manufacturers. Availbale at: http://www.nam.org/s_nam/bin.asp?CID=216&DID=227525&DOC=FILE.PDF.

³⁸US Patent and Trademark Office.2006. USPTO Annual List of Top 10 Organizations Receiving Most U.S. Patents. January 10, 2006. See http://www.uspto.gov/web/offices/com/speeches/06-03.htm

³⁹CERN. Internet Homepage. http://public.web.cern.ch/Public/Welcome.

⁴⁰American Association for the Advancement of Science. 2004. "Trends in Federal Research by Discipline, FY 1976-2004." October. Available at: http://www.aaas.org/spp/rd/disc04tb.pdf and http://www.aaas.org/spp/rd/discip04c.pdf.

⁴¹Centers for Medicare and Medicaid Services. 2005. National Heath Expenditures. Available at: http://www.cms.hhs.gov/NationalHealth ExpendData/downloads/tables.pdf.

⁴²In: Wallace, Kathryn. 2005. "America's Brain Drain Crisis Why Our Best Scientists are Disappearing, and What's Really at Stake." Readers Digest. December.

⁴³Louis V. Gerstner, Jr. Former Chairman, IBM In The Teaching Commission. 2004. Teaching at Risk: A Call to Action. New York: City University of New York. See www.theteachingcommission.org.

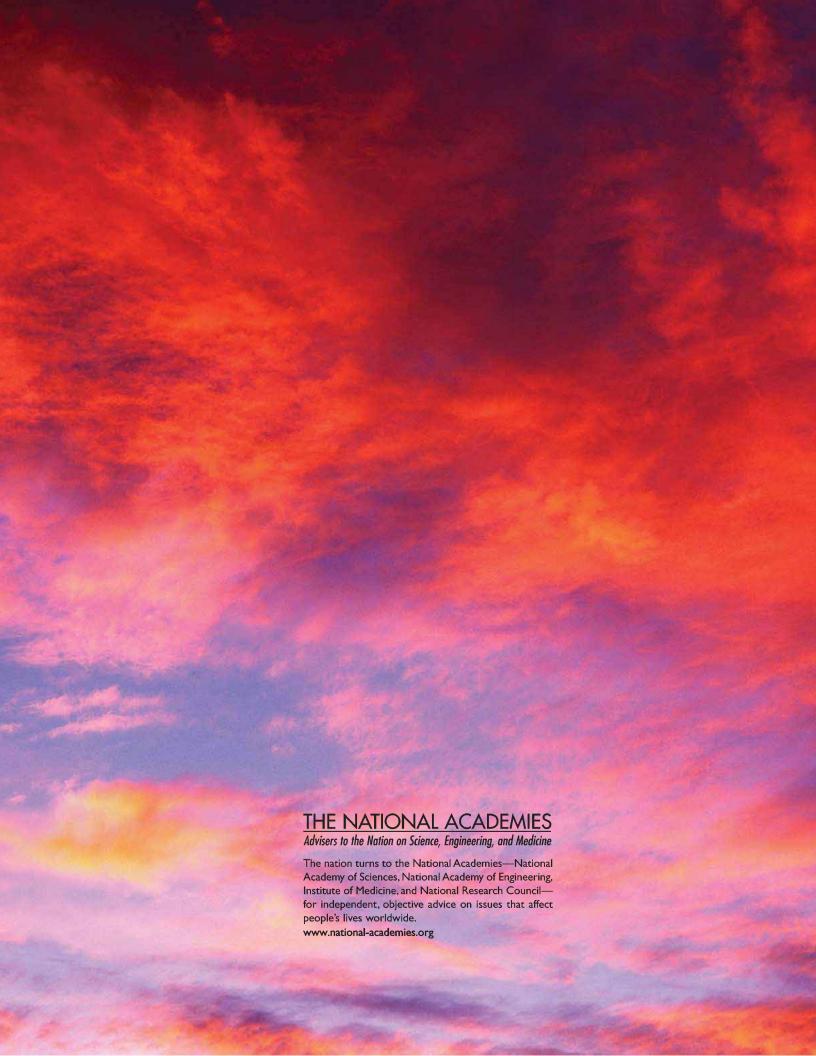
⁴⁴Remarks by Jeffrey R. Immelt to Economic Club of Washington as reported in Neil Irwin. 2006. "US Needs More Engineers, GE Chief Says." Washington Post. January 23, 2006.

⁴⁵Craig Barrett. 2006. Comments at public briefing on the release of The Gathering Storm report. October 12, 2005. See http://www.national academies.org/morenews/20051012.html.

⁴⁶Bill Gates. 2005. Speech to the National Education Summit on High Schools. February 26. Available at: http://www.gatesfoundation.org/Media Center/Speeches/BillgSpeeches/BGSpeechNGA-050226.htm.

⁴⁷William Jefferson Clinton "Commencement Address at Morgan State University in Baltimore, Maryland." May 18, 1997 Government Printing Office. 1997 Public Papers of the Presidents of the United States, Books I and II. Available at: http://www.gpoaccess.gov/pubpapers/wjclinton.html.

⁴⁸Remarks by President George W. Bush in meeting with High-Tech Leaders. March 28, 2001. Available at: http://www.whitehouse.gov/news/releases/ 2001/03/20010328-2.html.



PROTECTING MARYLAND'S

C MPETITIVE DGE

An Action Summit Hosted by the University of Maryland

A CALL TO ACTION

Over the past several years, America has watched other nations take vigorous competitive strides by investing heavily in science and technology. The United States has not adequately responded to this challenge, endangering our nation's dominance in these fields. Part of the answer lies in an increased federal commitment to education and basic research. But it is also necessary for the public and private sectors in Maryland to respond, as well.

Last year, a National Academies committee issued a report, *Rising Above the Gathering Storm*, making the case for federal investment and proposing specific action steps. Since then, legislation based on the report's recommendations has been introduced in Congress and President Bush has proposed an American Competitiveness Initiative.

That is an important start, and we remain hopeful that these initiatives will bear fruit. But federal action alone will not get the job done. Much of what needs fixing will require state and grassroots action. It is especially important for all of us in the state of Maryland to improve the "pipeline" of talent to make sure we have world-class scientists, engineers, mathematicians and teachers.

There are many steps we can take to improve K–12 achievement in math and science, stimulate basic research and innovation, and fill the science and technology pipeline. Beyond this, the state can further distinguish itself by taking steps to strengthen the overall math and science capabilities of all students—even if they do not plan scientific careers. Science thrives amid an appreciation of its principles and methods and a strong foundation in math and science will pay dividends for all students—no matter their field of study.

To transform these opportunities into action, the University of Maryland and 19 co-sponsoring organizations held a statewide summit, on April 26, 2006, to stimulate a coordinated grassroots response to these competitiveness issues. The driving force behind Protecting Maryland's Competitive Edge was to serve as a catalyst, the nexus where important interactions would take place.

State government cannot do it alone; neither can the private sector, school systems or universities. The key to quick and meaningful action lies in collaborations and coordination among these sectors. Many of the linkages already exist, but we also need to look for logical new partnerships to help get the job done.

Our main task was to identify issues and opportunities, identify partnerships and collaborations; then develop a series of short- and long-term recommendations that move the State forward.

In working panel sessions, participants—including high-level leaders from the various sectors, people who can get things done—talked about the problems and suggested some specific follow-up actions.

You will find some of these briefly summarized by the moderators who led the discussions.

"The driving force behind Protecting Maryland's Competitive Edge was to serve as a catalyst, the nexus where important interactions would take place."

Among other things,

they reported significant connections among the six panels, which suggested that the problems are systemic—high among them is the need to kindle an interest and fascination in students as early as kindergarten about careers in science, technology, engineering, and math (STEM). There were also calls for some creative recruiting of teachers. Several participants spoke of the need for more collaboration, perhaps a task force that could implement one of the suggestions—and I could not agree more. We encourage those leaders to get involved.

If we are to make the most of this unique opportunity, we must think seriously and realistically about the followup. The Summit was just the beginning (a start at the top to get to the bottom).

Maryland is the first to face the state and regional challenges directly. At this summit, and in the following months, Maryland has an opportunity to create and share a vision for how America can control its destiny in this highly competitive arena.

C. D. Mote, Jr.

President, University of Maryland Glenn L. Martin Institute Professor of Engineering

PANEL RECOMMENDATIONS

About the Recommendations...

The following panel recommendations represent only some of the ideas generated by participants at the April 26, 2006 summit, *Protecting Maryland's Competitive Edge*. The approximately 250 stakeholders who took part in the panel sessions came to brainstorm and offered many ideas and approaches. These highlights suggest some of the most practical starting points for action.

The key word here is "action." Maryland is the first state to host this kind of high-level meeting since the National Academies' report, *Rising Above the Gathering Storm*, came out last year. This summit has generated genuine excitement among Maryland's business leaders, educators, engineers and scientists, as well as the national organizations that focus on competitiveness issues. Summit participants recognized the need for Maryland to pursue grassroots actions to strengthen its own competitiveness edge and the important role that all stakeholders—especially major research universities—can play. Other states are likely to follow with efforts on their own behalf.

IMPROVING K-12 SCIENCE AND MATHEMATICS EDUCATION

Richard Steinke, deputy state superintendent, Maryland State Department of Education

There is a need to change perceptions about science—technology—engineering—mathematics (STEM). A recent survey found that 84 percent of U.S. middle school students would rather clean their rooms, take out the garbage or go to the dentist than do math homework. Obviously we have a lot to do. Some participants suggested an organized information campaign, and that may be a start. Others spoke of more fundamental changes.

From kindergarten, children need more opportunities to experience how science, technology and math are part of their everyday world. Yet, we heard again that the scale of solutions is too small for the scale of the challenges. While we have many excellent schools and teachers, we do not have enough. It will take more to reach children who have never imagined a serious future in science, technology, engineering and mathematics—a talent pool we cannot afford to ignore.

Panel 1 Recommendations

- 1. Identify model programs, which offer government and corporate retirees certification for K-12 teaching credentials (IBM model) and market those programs to government and corporate leaders.
- 2. Develop a group to follow up.
- Approach the Boy Scouts and Girl Scouts in Maryland to develop a "Science and Math" merit badge.

HIGHER EDUCATION—RECRUITMENT AND RETENTION OF THE BEST AND BRIGHTEST STUDENTS, SCIENTISTS AND ENGINEERS

Steven Knapp, provost and senior vice president for academic affairs, Johns Hopkins University

How do we plug the leaky pipeline of talented students and teachers? Students are losing interest, and the education pipeline leaks potential talent at every point from the lower grades into higher education. One way to address this problem is to focus on the entire spectrum from "K through Gray." For example, we can find an untapped resource in the retiring personnel from government and industrial labs around the state who might teach science—technology—engineering—math (STEM).

Marketing to students and parents is a priority, responding to negative cultural signals that STEM fields are "boring," "nerdy," "too difficult" or lacking in opportunities. Also, we need to improve science teaching, making it more inspiring and connect science and engineering to real-world experiences. Higher education can help by developing more effective techniques for teaching in the lower grades. Communication with industry can help us identify the skills needed in today's world and tomorrow's.

Panel 2 Recommendations

- Hold a statewide Maryland STEM recruiting job fair for college seniors with representatives from government and industry.
- 2. Develop a model outreach program that all Maryland universities can use to more actively recruit science and engineering students from Maryland high schools.
- Develop a high-level action group to identify relevant issues and resources, and then lead implementation of recommendations.

COMMITMENT TO LONG-TERM BASIC RESEARCH

William Jeffrey, director of the National Institute of Standards and Technology

In basic research, Maryland starts from a position of strength because of the presence of federal government laboratories, as well as strong research universities and a highly trained workforce. By many measures, Maryland ranks at the top of the nation in federal R&D investment on a relative scale. Private industrial R&D spending, however, is significantly below the federal support levels. Leveraging the presence of the federal government assets to benefit the future of the state's enterprises is a high priority.

Panel 3 Recommendations

1. Form a task force to identify Maryland's research strengths and needs and then to propose strategies to fill the gaps. It is critically important to have topnotch university research facilities to help attract and accommodate more federal and private dollars. The goal is to be more facile at leveraging Maryland's research strengths. A task force might undertake an assessment of the physical infrastructure for basic

- research in the states it considers aspirational peers and determine what Maryland's universities need to do to achieve a commensurate infrastructure.
- 2. Hold a STEM roundtable for Maryland state legislators to identify the benefits of a math—and science—based economy in the state.
- 3. Create a Maryland Competitive Edge Task Force comprised of university, business and industry leaders to propose steps that will promote Maryland competitiveness in basic research across state and federal government, business and education.
- Ask the governor to proclaim Maryland as an "Innovation Hot Spot" or "Informatics Corridor" to promote support of a math and science-based economy.

INCENTIVES FOR INNOVATION, ENTREPRENEURSHIP AND TECHNOLOGY TRANSFER

Christopher C. Foster, deputy secretary, Maryland Department of Business and Economic Development

It is clear that many of these problems are systemic. Workforce development is Maryland's number one issue. For example, the lack of women in the STEM workforce really hurts Maryland's competitiveness. Nearly 80 percent of graduates who leave the state for their first job are not coming back. We have to do a lot more to make sure they get jobs here.

On the incentive side, the state needs to change mindsets that are stuck in the old economy. Basic tax credits, for example, do not work for young innovative companies operating at a net loss for many years; they do not yet owe taxes. Instead of thinking about a government that is just business-friendly, we have to be innovation-friendly.

Panel 4 Recommendations

- 1. Arrange for as many Maryland-based federal labs as possible to get the "Entrepreneurial Boot Camp" series from MTECH (U. of Maryland).
- 2. Maryland should undertake a systematic review of state regulations and laws that may provide barriers for innovation and new business location and growth.
- 3. Develop a group in Maryland (university, industry, government) to specifically identify major high-technology corporations to move all or part of their operations to the state.

FOSTERING EMERGING TECHNOLOGIES— ENERGY

James Harkins, director, Maryland Environmental Service

We must take a holistic approach, perhaps by forming a consortium on energy that involves government, the business sector and higher education. That three-legged stool can lead to a better working relationship. With a close partnership, we can develop an energy strategy for the state and make sure we are accessing all the available federal research dollars in this area. There is a lot of money out there for innovative programs.

Panel 5 Recommendations

- 1. Form a Maryland Energy Alliance (university, industry, government) to pool research and programmatic ideas for Maryland citizens to conserve energy.
- 2. Develop a Maryland public awareness campaign to encourage energy conservation.
- 3. Identify existing energy conservation model programs and expand them (e.g., BP Solar Program).

JOB CREATION AND WORKFORCE DEVELOPMENT

Gino Gemignani, chair, Governor's Workforce Investment Board; senior vice president, Whiting-Turner Construction

There is no apparent center of gravity for this movement in Maryland. The state needs a clear focal point with a broad enough depth of field that we can see short—and long-term.

We must examine Maryland's untapped labor pool. Approximately 900,000 people are not in the workforce in a meaningful way. We tend to think of them as people with very severe problems, but some problems are more manageable, like language. We have a number of scientists and engineers separated from a wonderful job only by a language barrier.

Also, business really needs to get more involved in education—not simply sending a check, but getting into the classroom to inspire young people early on. We are not just preparing students to work in Maryland. We operate in a global economy, and students need to be trained in that perspective from the very beginning.

Panel 6 Recommendations

- 1. State should support a public service campaign aimed at middle and high school students about careers in science and technology and the skills for the future.
- 2. Create a statewide "Competitive Edge Scholarship" program that is supported by the state, businesses and federal laboratories. Such a fund will provide scholarships for students entering science, mathematics and engineering at the college level, with a "guaranteed job opportunity" upon graduation. Businesses and the federal labs could participate by giving preference to those graduating from Maryland universities (a Maryland first recruitment policy); the state could participate by directing merit scholarship money preferentially into these fields.
- 3. Create a working group (university, business, and government) to advance the recommendations and explore logical next steps.

PANEL PARTICIPANTS

Panel 1: Improving K-12 Science and Mathematics Education

Moderator: Richard J. Steinke, Deputy State
Superintendent for Instruction and Academic
Acceleration, Maryland State Department of Education
Panelists: Joe A. Hairston, Superintendent, Baltimore
County Public Schools; Katharine Oliver, Assistant State
Superintendent, Division of Technology and Adult
Learning; James F. Pitts, Corporate Vice President and
President, Northrop Grumman Electronic Systems

Panel 2: Higher Education—Recruitment and Retention of the Best and Brightest Students, Scientists and Engineers

Moderator: Steven Knapp, Provost and Senior Vice President for Academic Affairs, Johns Hopkins University

Panelists: Judy E. Ackerman, Vice President and Provost, Montgomery College, Rockville Campus, Calvin Burnett, Secretary, Maryland Higher Education Commission; Ann G. Wylie, Assistant President and Chief of Staff, Professor of Geology, University of Maryland

Panel 3: Commitment to Long-Term Basic Research

Moderator: William A. Jeffrey, Director, National Institute of Standards and Technology (NIST)

Panelists: Evan Jones, Chairman and CEO, Digene; Aris Melissaratos, Secretary, Maryland Department of Business and Economic Development; Theodore O. Poehler, Vice Provost for Research, Johns Hopkins University

Panel 4: Incentives for Innovation, Entrepreneurship and Technology Transfer

Moderator: Christopher C. Foster, Deputy Secretary, Maryland Department of Business and Economic Development

Panelists: Julie Coons, President, Tech Council of Maryland; Henry "Pete" Linsert, Jr., Chairman and Chief Executive Officer, Martek Biosciences Corporation; Nariman Farvardin, Dean, A. James Clark School of Engineering, University of Maryland; Renée M. Winsky, Interim Executive Director, Maryland Technology Development Corporation (TEDCO)

Panel 5: Fostering Emerging Technologies—Energy

Moderator: James M. Harkins, Director, Maryland Environmental Service.

Panelists: Bryan Eichhorn, Professor, Department of Chemistry and Biochemistry, University of Maryland; Benjamin H. Wu, Esq., Assistant Secretary, Business Development, Capital Region, Maryland Department of Business and Economic Development; William C. Poulin, Director of Products North America, BP Solar

Panel 6: Job Creation and Workforce Development

Moderator: Gino J. Gemignani, Jr., Senior Vice President, The Whiting-Turner Contracting Company Chairman, Governor's Workforce Investment Board. **Panelists:** James D. Fielder, Secretary, Maryland

Department of Labor, Licensing and Regulation;
Barbara Krumsiek, President and CEO, Calvert Group,
Ltd.; Chair-Elect, Greater Washington Board of Trade;
Edward Montgomery, Dean, College of Behavioral and
Social Sciences, University of Maryland

Co-Sponsors

- Baltimore/Washington Corridor Chamber of Commerce (BWCC)
- Federal Laboratory Consortium for Technology Transfer Mid-Atlantic Region (FLC)
- Greater Baltimore Committee (GBC)
- Greater Baltimore Technology Council
- Greater Washington Board of Trade
- Johns Hopkins University
- Maryland Association of Community Colleges (MDACC)
- Maryland Business Roundtable for Education
- Maryland Chamber of Commerce
- Maryland Department of Business and Economic Development (DBED)

- Maryland Economic Development Association (MEDA)
- Maryland Independent College and University Association (MICUA)
- Maryland State Department of Education (MSDE)
- Maryland Technology Development Corporation (TEDCO)
- Prince George's Black Chamber of Commerce
- Regional Manufacturing Institute (RMI)
- Research Parks Maryland (RPM)
- Tech Council of Maryland
- University System of Maryland (USM)

A SNAPSHOT OF SCIENCE & TECHNOLOGY IN THE STATE OF MARYLAND

Maryland ranks high nationally in areas that support a strong and competitive knowledge-based economy. In part this reflects a highly-trained workforce and an extensive concentration of research facilities, including major federal laboratories. For example, the state of Maryland is:

- No. 1 nationally in percentage of professional and technical workers in the workforce;
- No. 2 nationally in federal research and development spending.

On some other measures the state does not rank as high. This snapshot offers a brief picture of the state's scientific-technological strengths and vulnerabilities.

OVERALL POSITION

Maryland ranks No. 4 among the states on a Science and Technology Index created by the Milken Institute. On five separate indices, Maryland scored near the top, with an average rating of 78.19.

1	Massachusetts	84.35
2	California	78.86
3	Colorado	78.77
4	Maryland	78.19
5	Virginia	72.27

The report notes: "Maryland's most poignant strengths are in the life sciences and communications technology, two sectors with extremely bright long-term prospects, and where it has some of the best and deepest talent in the nation."

Source: "State Technology and Science Index," Milken Institute, March 2004

WORKFORCE

- Percentage of professional and technical workers in the workforce (2002): Maryland ranks No. 1 among the states (24 %)
- Doctoral scientists & engineers (2001): 2nd highest concentration of all states; No. 2 in employed Ph.D. scientists and engineers per 100,000 employed workers (938.5)

 Graduate and professional degrees/age 25+ (2000): No. 2 among the states (13.4%)
 Source: Maryland Department of Business and Economic Development

RESEARCH AND DEVELOPMENT

- Federal R&D obligations (2002): Maryland ranks No. 2 among the states (\$7.2 billion);
 No. 2 among states in federal R&D per capita
- Academically-based federal research: More than \$1 billion annually performed by the University System of Maryland and Johns Hopkins University

In part this federal spending reflects the proximity to federal research centers (e.g., National Institute of Standards and Technology, National Institutes of Health, Johns Hopkins University-Applied Physics Laboratory, University of Maryland Center for Advanced Study of Language) as well as to federal customers (e.g., National Security Agency, NASA Goddard Space Flight Center, etc.)

Source: Maryland Department of Business and Economic Development

- Research and development as a percentage of gross state product: Maryland ranks No. 9 among the states (\$10.1 million of \$213 million in 2003)
- Federal R&D as percentage of all research spending: Maryland ranks No. 9 among the states (37%); federal=41% of all R&D performed in Md., Va., and D.C.; 56% of all federal R&D spent in Ca., N.M., Md., Va., and D.C.
- R&D performed by industry: No. 13 among the states

"R&D performance is geographically concentrated in the United States, Over 50% of U.S. R&D is performed in only seven states. ... One way to control for the size of each state's economy is to measure each state's R&D level as a percentage of its gross state product (GSP)... Some of the states with the highest R&D to GSP ratios include Michigan, home to the major auto manufacturers; Massachusetts, home to a number of large research universities and a thriving high-technology industry; and Maryland, home to the National Institutes



of Health."

Source: NSF Science and Engineering Indicators 2006

Note: The Milken Institute report says Maryland's high rank in federal research funding reflects the ring of U.S. laboratories located near Washington, D.C. It concludes that this is both a strength and a potential vulnerability should federal spending priorities change.

HUMAN CAPITAL INVESTMENT

Higher Education

National

- Science and engineering doctorates awarded (2002): Maryland ranked No. 11 among the states (638); 33% were in the life sciences, 20% in engineering, and 20% in social sciences.
- Science/Technology degrees awarded (2000– 2001): No. 15 among the states (2,004 degrees)
- Graduate students attending S&E doctorategranting institutions (2002): No. 12 among the states (12,204)

Source: National Science Foundation; University of Maryland analysis

 College freshmen earning bachelor's degree within six years: No. 2 among all states (64%)

Source: Center for American Progress report and Institute for America's Future: The State We're In: An Education Report Card for the State of Maryland

 Student aid expenditures per full-time undergraduates: state of Maryland ranks in the second quartile nationally

Source: NSF Science and Technology Indicators 2006

International

- Science and engineering degrees (percent of total undergraduate degrees): Japan, 66%;
 China, 59%; Germany, 36%; U.S. 32%;
- Engineering degrees: U.S., 5%; China, 50%
 Source: National Academy of Engineering

K-12 STEM performance (Science-Technology-Engineering-Math)

National Educational Proficiency Testing

- 4th grade math: No. 21 nationwide (38%; 2004) in the percent at or above proficiency level; No. 31 (21%) below proficiency
- 8th grade math: No. 23 nationwide (30%; 2005) in the percent at or above proficiency; No. 34 (34%; 2005) in the percent below proficiency
- 4th grade science: No. 23 nationwide (24%; 2000) in the percent at or above proficiency level; No. 28 (39%; 2000) in the percent below proficiency
- 8th grad science: No. 21 nationwide (27%; 2000) in the percent at or above proficiency

level; No. 23 (43%; 2000) in the percent below proficiency

Source: Kids Count and U.S. Department of Education

- High school graduates academically ready for college: No. 8 nationwide (39%)
- High school graduation rate: No. 17 nationally (77%)

Source: Center for American Progress report and Institute for America's Future; The State We're In: An Education Report Card for the State of Maryland

- Students taking advanced placement calculus exam (2004): 12% (national average= 7%)
 Source: U.S. Department of Education
- Teen high school dropouts (2004): No. 20 nationwide (7%)

Source: Kids Count and U.S. Department of Education

International

"In a recent international test involving mathematical understanding, U.S. students finished in 27th place among participating nations. About two-thirds of students studying chemistry and physics in U.S. high schools are taught by teachers with no major or certificate in the subject. In the case of math taught in grades five through 12, the fraction is one-half."

Source: National Academy of Engineering

ENTREPRENEURIAL ENVIRONMENT

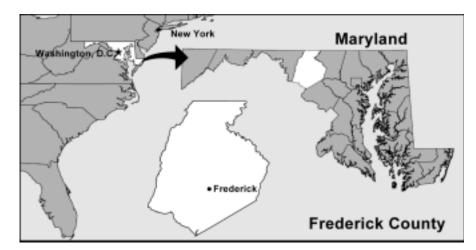
- Patents awarded per 1,000 individuals in science and engineering occupations (2003): Maryland ranks in the third quartile nationally; California led nation (22% of all patents)
- Venture capital disbursed per \$1,000 of gross state product (2003): Maryland ranks in the first quartile nationally; No. 1 California had more than four times as much venture capital spending as Maryland
- High-technology share of all business establish ments (2002): Maryland ranks in the first quartile nationally; Maryland's percentage comparable to Massachusetts and higher than California and Florida (the states with the biggest growth in high tech industries)
- Average Small Business Innovation Research (SBIR) program award dollars per \$1 million of gross state product (2001–03): Maryland ranks in the first quartile nationally; more than 2.5 times greater than California's but nearly half as great as Massachusetts

Source: NSF Science and Technology Indicators 2006

FREDERICK COUNTY, MARYLAND

BRIEF ECONOMIC FACTS





Frederick County is Maryland's largest county in size—663 square miles. The City of Frederick, the county seat, is intersected by five interstate and national highways that provide easy access to Baltimore (46 miles), Washington, D.C. (43 miles), Gettysburg, Pa. (32 miles), Harpers Ferry, W.Va. (21 miles), and Leesburg, Va. (25 miles). It is home to the 5,700-acre Catoctin National Park, site of the Camp David Presidential Retreat. Frederick County is also Maryland's largest dairy producer, providing one-third of the state's milk production.

Frederick County's 5,450 businesses employ 76,200 workers; an estimated 127 of these businesses have 100 or more workers. Frederick County boasts employers including Bechtel, BP Solar, Cambrex Bio Science, CitiMortgage, Fort Detrick, MedImmune, and State Farm Insurance. The county has experienced a significant increase in high-tech companies, allowing more residents to work near where they live.

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LOCATION		
Driving distance from F	rederick:	
	(in miles)	(in kilometers)
Atlanta, GA	630	1,014
Baltimore, MD	46	74
Boston, MA	437	703
Chicago, IL	636	1,023
New York, NY	231	372
Philadelphia, PA	141	227
Pittsburgh, PA	180	290
Richmond, VA	146	235

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CLIMATE	
Yearly Precipitation (inches)	42.3
Yearly Snowfall (inches)	22.1
Summer Temperature (°F)	72.2
Winter Temperature (°F)	32.5
Duration of Freeze-Free Period	151 days
Note: Temperature and precipitation data based on	30-year averages.
National Oceanic and Atmospheric Administration; Months of Climatology.	Maryland State

POPULATION				
	Frederick County	laryland Part of Washington, D.C. Metro *	Maryland	
1990 Census	150,208	1,788,314	4,780,753	
2000 Census	195,277	2,065,242	5,296,486	
2005 Estimate	221,850	2,230,300	5,609,200	
2010 Projection	243,200	2,365,000	5,907,575	
2015 Projection	265,600	2,466,500	6,127,225	
*Represents Calvert, Charles, Frederick, Montgomery and Prince George's Counties.				
Selected areas population (2000 Census): Brunswick 4 894				

Selected areas population (2000 Census): Brunswick, 4,894; Frederick, 52,767; Middletown, 2,668; Mount Airy, 6,425; Thurmont, 5,588; Walkersville, 5,192.

U.S. Bureau of the Census; Maryland Department of Planning.

POPULATION DISTRIBUTION			
(2005 Estimate)			
Age	Number	Percent	
Under 5	16,090	7.3	
5 - 19	50,770	22.9	
20 - 44	78,080	35.2	
45 - 64	55,590	25.1	
65 and over	21,330	9.6	
Total	221,850	100.0	
Note: Columns may not add due to rounding.			
Maryland Department of Planning.			

Washington, DC

LABOR AVAILABILITY				
(by place of residence) Frederick County				
Civilian Labor Force (2004 annual avera	ages):			
Total civilian labor force		115,994		
Employment		112,262		
Unemployment		3,732		
Unemployment rate		3.2%		
Residents commuting outside the County to work (2000):	42,046	41.1%		
Employment in selected occupations (2000):				
Management, professional and related	41,615	40.5%		
Service	13,235	12.9%		
Sales and office	26,456	25.7%		
Production, transp. and material moving	9,617	9.3%		
Maryland Department of Labor, Licensing and Regulation, Office of Labor Market Analysis and Information; Maryland Department of Planning in conjunction with U.S. Bureau of the Census.				

MAJOR EMPL	OYERS		
Firm	Product/Service Employ	ment	
Fort Detrick	Military installation	7,800	
Frederick Memorial Hosp.	Medical services	2,400	
SAIC	Medical research	2,000	
Wells Fargo Home Mortg.	Mortgage services	1,700	
United Health Care	Health insurance	1,600	
Bechtel	Engr., telecomm., constr.	1,500	
Frederick Community Coll.	Higher education	1,159	
State Farm Insurance	Insurance	929	
CitiMortgage	Operations center	917	
NVR Building Products	Wood building products	700	
Wal-Mart	Consumer goods	621	
JP Morgan Chase Bank	Operations center	610	
Mount St. Mary's University	Higher education	550	
Home Call	In-home medical services	480	
Structural Systems	Building components	480	
Hood College	Higher education	430	
Plamondon Companies	Hotels, restaurants, mgt.	410	
Cambrex Bio Science	Biological media, cultures	390	
Moore Wallace BCS	Business forms printing	380	
BP Solar	Solar energy products	375	
Home Depot	Home improvement prod.	330	
H.L. Hartz	Men's clothing	314	
Invitrogen	Biotech research, enzymes	300	
Hood College	Higher education	288	
Trans-Tech	Ceramic components	282	
Frederick News Post	Newspaper	275	
Homewood Retirement Ctr.	Retirement community	275	
Expo Exchange	Conference services	270	
Frederick County Office of Economic Development; Maryland Department of Business and Economic Development.			

EMPLOYMENT				
(2004, by place of work)	Annual Average	Average Weekly		
Industry Em	ployment	%	Wage	
Federal government	3,183	3.6	\$1,199	
State government	655	0.7	680	
Local government	9,489	10.6	729	
Private sector	76,194	85.1	707	
Nat'l. resources and mining	545	0.6	563	
Construction	9,893	11.1	768	
Manufacturing	6,576	7.3	897	
Trade, transp., and utilities	16,042	17.9	581	
Information	1,645	1.8	858	
Financial activities	7,819	8.7	986	
Prof. and business services	11,970	13.4	920	
Educ. and health services	10,393	11.6	670	
Leisure and hospitality	8,163	9.1	258	
Other services	3,112	3.5	498	
Unclassified	36	0.0	640	
Total	89,521	100.0	727	
Note: Percentages may not add due to rounding.				
Maryland Department of Labor Licensing and Regulation, Office of				

Maryland Department of Labor, Licensing and Regulation, Office of Labor Market Analysis and Information.

HOURLY WAGE RATES			
(2005)			Experi-
Selected Occupations:	Median	Entry	enced
Accountants	\$27.00	\$18.25	\$39.50
Biological technicians	23.75	15.00	26.50
Bookkeeping/accounting clerks	15.25	11.75	17.75
Computer support specialists	23.25	12.00	30.25
Customer service representatives	13.50	10.50	17.00
Electrical engineers	26.25	24.75	31.50
Electronic engineering technicians	23.25	16.25	27.75
Freight, stock and material			
movers, hand	10.00	7.25	11.50
Industrial truck operators	13.75	11.00	16.00
Machinists	18.00	13.75	20.75
Network administrators	40.50	27.50	45.00
Packers and packagers, hand	9.50	7.50	11.75
Secretaries	16.75	12.25	19.00
Shipping/receiving clerks	12.75	10.75	14.75
Team assemblers	11.25	8.75	13.50
Note: These wages are an estimate of what workers might expect to			

receive in Frederick County. Wages may vary by industry, employer, and locality. Maryland Department of Labor, Licensing and Regulation, Office of

Labor Market Analysis and Information.

EDERICK COUNTY, MARYLA

TAX RATES

Corporate Income Tax (2006)

Base - Federal taxable income. Personal Income Tax (2006)

Base - Federal adjusted gross income.

*Graduated tax peaking at 4.75% on taxable income over \$3,000.

PERSONAL INCOME	
Per Capita Personal Income - 2003	
Frederick County	\$35,423
Maryland	\$37,446
U.S.	\$31,472
Total Personal Income (millions) - 2003	
Frederick County	\$7,567
Maryland	\$206,412
U.S.	\$9,151,694
U.S. Department of Commerce, Bureau of Econ	nomic Analysis.

T. I.B				+=,===.	
Total Personal Income (millions) - 2003		Sales and Use Tax (2006)	none	5.0%	
Frederick County	\$7,567	Exempt - sales for resale; manufacture			
Maryland	\$206,412		materials; manufacturing machinery and equipment; pur-		
U.S.	\$9,151,694	chases of materials and equipment used in R&D and testing of finished products; purchases of computer programs for			
U.S. Department of Commerce, Bureau of Econom	ic Analysis.	reproduction or incorporation into ano for resale.			
		Real Property Tax (FY 2006)	\$1.00	\$0.132	
		Effective rate per \$100 of assessed valued in addition to this rate, there are some and/or special taxing areas in the courarea, a municipal rate will also apply.	miscellaneous		
		Business Personal Property			
		Tax (FY 2006)	none	none	
		No county personal property tax on or \$2.50/\$100 applicable to utility operatir In an incorporated area, a municipal ra	ng property on		
		Major Tax Credits Available			
		Job Creation; Research and Developm	ient.		
		Maryland State Department of Assessments Comptroller of the Treasury.	s and Taxation;		
		BUSINESS/INDUSTRIA	L PROP	ERTY	
EDUCATION		Frederick County has sites available whi research and development, office and in			
Educational Attainment - age 25 and over (2000):		in-place amenities. Over 30 industrial and office parks have available sites ranging from one to 200 acres with easy access			

High School Graduate or Higher	87.1%
Bachelor's Degree or Higher	30.0%

Public Schools

Number: 34 Elementary; 13 Middle/Combined; 10 High

Enrollment: 39,489 (Sept. 2004) Cost per Pupil: \$8,427 (2003-2004) Students per Teacher: 15.5 (Oct. 2004)

High School Career/Tech Enrollment: 7,562 (2005)

High School Graduates: 2,610 (June 2004)

Private Schools

Number: 37; Enrollment: 5,318 (Sept. 2004)

Higher Education

(2004)	Enrollment	
2-Year Institution		
Frederick Community College	4,648	442
4-Year Institutions		
Hood College	1,952	339
Mount St. Mary's College	2,125	484

Several major universities are within an easy commute of the County. In the Baltimore-Washington area, there are approximately 65 accredited institutions of higher education.

Maryland State Department of Education and Higher Education Commission: U.S. Bureau of the Census.

Frederick County

none

2.96%

Maryland

7.0%

4.75%*

to a vast transportation network. The inventory of available office, flex and industrial space totals over 1.8 million square

The Frederick County Office of Economic Development uses a comprehensive site database, CoStar Property, to assist businesses in the site selection process. The following are selected industrial sites concentrated in the Frederick area: 270 Technology Park, Ballenger Creek Center, Center at Monocacy, Dudrow Business Park, Frederick Airport Park, Frederick County Advanced Tech Park, Intercoastal Industrial Center, Knowledge Farms, Omega Center, Riverside Industrial Park, Stanford Industrial Park, Urbana Office & Research Center, Wedgewood Business Park, and Westview Corporate Campus. All of these locations offer outstanding opportunities for information technology, bioscience or manufacturing operations.

Business Incubator

Frederick Innovative Technology Center, Inc., Frederick

Market Profile Data

Land - cost per acre	Low	High	Average
Industrial	\$76,464	\$479,233	\$164,239
Office	\$87,120	\$320,000	\$203,560
Rental Rates - per square foot			
Warehouse / Industrial	\$5.00	\$11.00	\$6.73
Flex / R&D / Technology	\$4.50	\$15.00	\$11.26
Class A Office	\$21.00	\$26.89	\$23.32
Frederick County Office of Economic Development.			

FREDERICK COUNTY, MARYLAND

TRANSPORTATION

Highways: I-70, I-270, U.S. 15, U.S. 40 and U.S. 340.

Mass Transit: MARC (commuter rail) service to Washington, D.C. and Amtrak. Public bus transportation throughout Frederick City and connecting to other municipalities.

Rail: CSX Transp.; Maryland Midland (short line service). **Truck**: 34 motor freight common carriers serve the county.

Water: Served by the Port of Baltimore, 50' channel; a leading U.S. automobile and break-bulk port; six public terminals including the state-of-the-art Intermodal Container Transfer Facility.

Air: Served by Baltimore/Washington International Thurgood Marshall Airport (BWI) as well as Reagan Washington National and Washington Dulles International Airports. Frederick Municipal Airport offers jet and turboprop charter service and ILS, VOR and GPS approaches.

UTILITIES

Electricity: The Allegheny Power System and Thurmont Municipal Light Company. Customers of investor-owned utilities and major cooperatives may choose their electric supplier.

Gas: Natural das is supplied by Frederick Gas Company, a division of Washington Gas. Baltimore Gas and Electric serves Mount Airy. Rocky Ridge and Emmitsburg are served by the South Penn Gas Company.

Water: Municipal systems in Brunswick, Emmitsburg, Frederick, Middletown, Mount Airy, Myersville, Thurmont, Walkersville, Woodsboro, and 18 county-operated plants which serve a wide geographical area.

Sewer: Municipal systems in Brunswick, Emmitsburg, Frederick, Middletown, Mount Airy, Myersville, and Thurmont. The County operates 15 plants serving a wide geographical area.

Telecommunications: Predominant Local Carrier - Verizon Maryland. Long Distance Carriers - AT&T, MCI, Sprint, LCI, and numerous additional carriers, resellers and providers of WATS, MTS, voice, paging systems, data, video networking, CATV, satellite communications systems and other wireless systems. ISDN digital switching and fiber optics available at many locations throughout the County.



Robert L. Ehrlich, Jr., Governor Michael S. Steele, Lt. Governor Aris Melissaratos, Secretary

GENERAL INFORMATION

County Seat - Frederick

Government - Five commissioners elected at large for four-year

terms.

Elevation - 200 to 1,895 feet above sea level

Land Area - 663 square miles

RECREATION and CULTURE

There are several major federal, state and municipal parks in Frederick County which include: Cunningham Falls, Gambrill. Gathland, and Washington Monument State Parks, Monocacy National Battlefield, Sugarloaf Mountain, C&O Canal Towpath and Catoctin Mountain National Park.

Among the numerous recreational activities in Frederick County visitors can enjoy golfing, fishing, hiking, ice skating, canoeing, swimming, orchard and winery tours, historic walking and motorcoach tours, visual and performing arts, art galleries, a zoological park, and minor league baseball.

There are many historical and cultural attractions that include the Schifferstadt Architectural Museum, the Hessian Barracks located on the grounds of the Maryland School for the Deaf, the Barbara Fritchie House, the Children's Museum of Rose Hill Manor Park, Francis Scott Key Monument and Grave, Roger Brooke Taney House/Francis Scott Key Museum, National Museum of Civil War Medicine, the Historical Society of Frederick County, the Delaplaine Visual Arts Center, Weinberg Center for the Arts, Seton Shrine Center, the Grotto of Lourdes. Lily Pon Water Gardens, Brunswick Railroad Museum, covered bridges, antique and specialty shopping.

Throughout the year Frederick County is host to numerous events and festivals that have a broad appeal to visitors. Among these events are the Frederick's annual In the Street Celebration, Brunswick Railroad Days, Candlelight Tour of homes, museums and historic houses of worship, Beyond the Garden Gates Tour, Rose Hill Days, Frederick Festival of the Arts, Maryland Christmas Show, Catoctin Colorfest, Frederick's Fourth of July Celebration, the Great Frederick Fair, New Market Days, Commemoration of the Battle of Monocacy, Frederick Summer Concert Series, Brunswick Movies in the Park, Myersville Trolley Festival, Middletown Heritage Festival, Oktoberfest at Schifferstadt, Annual Craft Fair and more.

ECONOMIC DEVELOPMENT CONTACTS:

Technology Strategy and Business Development Maryland Department of Business & Economic Development 217 E. Redwood Street • Baltimore, Maryland 21202 Telephone: (410) 767-6870 • Toll Free: 888-ChooseMD

Fax: (410) 333-6792 TDD/TTY: (410) 333-6926 http://www.ChooseMaryland.org Frederick County Office of Economic Development **Business & Employment Center**

5340 A Spectrum Drive • Frederick, Maryland 21703 Telephone: (301) 694-1058 • Toll Free: (800) 248-2296

Fax: (301) 631-2340 • TDD: (301) 694-1672 E-mail: info@discoverfrederickmd.com http://www.discoverfrederickmd.com

Maryland Education Superlatives



Standards and Accountability For the sixth-straight year, Education Week has given Maryland an A for its K-12 standards and system of student testing and school accountability.

Source: Education Week



No Child Left Behind Compliance In July 2005, MGT of America gave Maryland high marks for its compliance with the No Child Left Behind Act. The national research and consulting firm commended Maryland in 58 areas, including reporting and accountability; standards-based curriculum; cross-divisional cooperation within MSDE; outreach to schools and to the public; technology infrastructure and access; and efforts to improve teacher preparation and professional development.

Source: MGT of America



Reading and Math Achievement For the second-straight year, all 24 school systems have improved their reading and math Maryland School Assessment scores. In all grades and both subjects, scores improved for African-American and Hispanic students and for students living in poverty, shrinking Maryland's race- and income-based achievement gap.

Source: 2005 Maryland Report Card



SAT Participation and Performance For the third-straight year, Maryland's average SAT score ranks #1 in the College Board's Middle States region. The state's 1026 cumulative score has risen 8 points since 2001. Additionally, the number of students taking the SAT rose again in 2005. More than 7 in 10 Maryland students now take the test, a 7-percent increase over 2004 and an 18-percent increase over 2001.



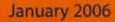
Career and Technology Education In July 2005, Maryland's SkillsUSA delegation won 16 medals at the organization's national conference. The team of secondary and post-secondary Career and Technology Education (CTE) students showcased their skills in 74 trade, technical, health occupations, and leadership competitions. Challenging 4,700 students from all 50 states, more than half of Maryland's CTE competitors finished in the top 10, and students in four career categories are officially best in the nation, winning gold medals.

Source: SkillsUSA



National Board Certified Teachers In December 2005, a record 160 Maryland teachers earned certification from the National Board for Professional Teaching Standards. Maryland now has 660 Board-certified teachers, ranking 15th in the nation. The voluntary certification process, which typically takes more than a year to complete, requires that teachers demonstrate how their activities strengthen student performance.

Source: National Board for Professional Teaching Standards





AP Participation and Performance Since 2001, Maryland has increased the number of students taking an Advanced Placement (AP) exam by 70 percent; the number of exams taken by 83 percent; and the number of exams earning a college-mastery score by 76 percent. In January 2005, the College Board ranked Maryland #2 in the nation in the proportion of graduating seniors who'd received a college-mastery score on one or more AP exams. Nearly one-fifth of the class of 2004 earned a score of 3 or higher. Source: The College Board



Supplemental Educational Services In June 2005, the Council of Chief State School Officers recognized Maryland's accessible and effective supplemental educational services (SES). The Council praised the SES resources provided to school systems; the way the state selects and monitors service providers; and the amount and quality of SES information that's made available to the public. Under the No Child Left Behind Act, certain schools not meeting performance standards must provide their students supplemental services, such as Source: Council of Chief State School Officers tutoring or after-school programs.



Comic Book Initiative In October 2005, The Daily Record named MSDE an Innovator of the Year for its Maryland Comic Book Initiative, which uses comics and graphic novels as a way of introducing reluctant readers to literature. Source: The Daily Record



Hurricane Katrina Relief Maryland students have raised \$1.4 million for the victims of Hurricane Katrina. Nearly 700 schools have participated in Maryland Kids Care, the largest charitable fundraising campaign in Maryland public school history. The campaign has become Source: Maryland State Department of Education a model for other states' fundraising efforts.



Education Grants Maryland received \$21.6 million in grants last fiscal year. The largest grants focus on improving math instruction in high-poverty middle and high schools (\$10.4 million); generating more accurate and timely data on individual student performance (\$5.7 million); and preparing low-income students for college (\$2.2 million).

Source: Maryland State Department of Education



Traumatic Brain Injury Resource In March 2005, Maryland received a Knowledge Exchange Award from the federal Traumatic Brain Injury (TBI) Program. Traumatic Brain Injury: An Educator's Guide won the program's "Most Popular Product" distinction, after having been downloaded more times from the TBI Technical Assistance Center Web site than any other state-developed product. MSDE worked with the Maryland Mental Hygiene Administration and the Brain Injury Association of Maryland on the guide.

> Source: U.S. Department of Health and Human Services Health Resources and Services Administration, Maternal and Child Health Bureau



MPOWER Card In April 2005, Maryland became the first state in the nation to offer one library card that's valid statewide. The MPOWER card allows patrons to check out and return lending materials to any one of Maryland's 174 public libraries.

Source: Maryland State Department of Education





About the National Science Center

The National Science Center is dedicated to motivate



and excite students across the nation about math, science, and technology. At The

National Science Center, math and science are not lifeless, boring subjects to be approached with

skepticism. Instead, they are fascinating areas of knowledge which are great fun to explore! The NSC strives to ignite the curiosity of young people and instill within them the desire to learn. They want to help America's youth experience the thrill of discovery!



Challenging. Entertaining. Educational.

Interactive. Visionary. Meeting the needs of so many in such creative ways. National in scope and national in impact. The National Science Center.

Read more about it at http://www.usaeop.com/
or http://www.usaeop.com/

Educational outreach programs across the nation make the NSC unique.



Welcome to the Army Educational Outreach Program (AEOP). The United States Army has long recognized that a scientifically and technologically literate citizenry is our nation's best hope for a secure, rewarding and successful future. For over 50 years, the Army has supported a wide range of educational opportunities in Science, mathematics, engineering and technology for our youth and their teachers.

Our nation's economy has greatly benefited from the technological achievements of the last century and is destined for greater achievements throughout the 21st century. Science, mathematics, engineering and technology will continue to play a dominant role in all aspects of everyday life in the 21st century. For this reason, the Army has created the AEOP, which greatly expands and integrates an array of Army educational opportunities for the future generations of America's workforce and their teachers.

The AEOP is comprised of Army-sponsored research, education, competitions, internships and practical experiences designed to engage and guide students and teachers in science, mathematics, engineering and technology. From kindergarten through graduate school, students of all proficiency levels, interests, and ethnic, economic and academic backgrounds are encouraged to participate in real world experiences involving these important disciplines. Programs involve interactive activities and knowledgeable mentors to introduce students to these areas. Events include school visits, neighborhood activities and community science fairs. Engineers, scientists, mathematicians and technology experts, who act as mentors and guides, introduce students to various levels of research and engineering and provide advice on career opportunities and training.

In AEOP, high-school students can choose from a wide range of educational challenges such as the Junior Science and Humanities Symposium or the International Mathematics Olympiad. For those in grades 6-9 who prefer cyberspace, eCYBERMISSION is an inclusive web-based science, mathematics and technology competition with significant monetary awards for small teams of students who are interested in open-ended challenges that are relevant and linked to their community. GEMS, SEAP, UNITE, ISEP and REAP provide hands-on internships to pre-college students, each program tailored to a different age and interest. Materials World Modules enables students and teachers from middle to high school to experience science through the process of self-discovery. AEOP programs are also available for college undergraduate and graduate students that include extensive scholarship opportunities available at numerous institutions across the country.

The Army invites parents, students and teachers in communities across America to become familiar with AEOP. Taking advantage of its numerous educational opportunities available in science, mathematics, engineering and technology will ensure that America will continue to maintain its technological leadership in a globally competitive world. For additional information, applications and deadlines, visit www.usAeop.com.

Army Educational Outreach Program

AEOP Programs

K-5

National Science Center Live! – Uses video and teleconferencing to enhance the quality of science and mathematics education in grades K-12.

6-12

- Gains in the Education of Mathematics & Science (GEMS) – Students in 8th to 12th grade intern for one to four weeks in an Army laboratory and learn technical skills. Advanced courses in subsequent years build upon prior experience.
- eCYBERMISSION Web-based science, math, and technology competition for 6th-9th grade students nationwide.
- Science & Engineering Apprentice Program (SEAP)

 Highly competitive, academically advanced, challenging summer internships that provide opportunities for dedicated high school students pursuing advanced studies.
- Research & Engineering Apprentice Program
 (REAP) Provides students a challenging scientific experience not readily available in high school.
- Materials World Modules (MWM) Encourages classroom students and teachers to apply science and math to real world applications.
- Uninitiates Introduction to Engineering (UNITE) – Provides socially and economically disadvantaged high school students academic courses on college campuses.
- Junior Science & Humanities Symposium (JSHS) – Annual high school science competition encouraging oral presentation skills and ethical conduct of original research.

- International Mathematical Olympiad (IMO) – The Army sponsors a team to represent the United States at the IMO, competing with teams from other countries.
- Internships Science & Engineering Program
 (ISEP) Assists the Construction Engineering
 Research Laboratory (CERL) researchers on
 projects during the summer prior to senior year
 in high school. All students are required to give a
 formal presentation of their research.

College Level Programs

- Women in Science Project (WISP) Created at Dartmouth College to encourage interested women to stay in mathematics, science, and engineering.
- Science & Technology Academic Recognition
 System (STARS) Internships for qualified
 undergraduates and fellowships/employment
 to graduate students at the Army Research
 Laboratory.
- Career Related Experience in Science & Technology (CREST) – Provides summer and/or part time employment to students for appointment to civilian engineer or scientist positions in the Army Intern Program.
- College Qualified Leaders (CQL) Paid internships for undergraduates seeking experience in medical reserach.
- Consortium of Universities of the Washington Metropolitan Area (CUWMA) - Places graduate students as Consortium research fellows and junior and senior undergraduate students as Consortium research assistants in Army labratories.

Continuity in Science Education from Middle School through College



A continuum of student research internships is essential to developing the talent extant in all young people. Beginning with middle school, we must foster, encourage and mentor future scientists through the necessary years of study, preparation and experience. Recognizing the potential of all youth of all backgrounds, ethnicities, geography, economic status and academic access, students experience a sequence of authentic research opportunities through three programs:

- Gains in the Education of Mathematics and Science (GEMS)
- Science and Engineering Apprentice Program (SEAP)
- College Qualified Leaders (CQL)

GEMS is a program designed and funded by the NIH and the Army that prepares interested middle/high school students for academically advanced programs. GEMS is dedicated to exciting students about science, technology, engineering and mathematics (STEM) through authentic laboratory research. The students are led by near-peer mentors who translate current research and scientific concepts into modules suitable for GEMS students.

GEMS Program Locations:

Walter Reed Army Institute of Research, MD; ARL-CISD, APG and ARL-A, Adelphi, MD*; GARRED, Redstone Arsenal, AL*; George Washington University School of Engineering, DC*; Salish-Kootenai College, MT*; West Frederick Middle School, MD. *WRAIR conducts training for near-peer mentors.





GEMS 1 modules include: Thompson's Coil, the String Thing or Stringray (wave mechanics), ceramics, brain injuries and seizures, mosquito dissection, liquid nitrogen ice cream, olfactory fatigue, Rube Goldberg designs and construction, etc. GEMS 2 modules include: Cooties (bacteria), breast cancer, neurotoxicity, maglev vehicles, cell wars, bioethics, engineering, bridge building, and computeraided design and construction of wooden models. GEMS 3 students attend for 4 weeks, and follow a more in-depth study program that includes a presentation and paper. Modules include: Cooties, cell wars, blood pressure, egg drop, mouthwash efficacy, logic puzzles, animal behavior, cloning and food chemistry.





SEAP students are academically advanced high school students (mostly 11th and 12th graders) selected to intern in an active research laboratory. Students complete a minimum of 8 weeks, a poster and paper, including a literature review.

Goals:

- Encourage students to pursue science and engineering careers.
- Acquaint qualified high school students with the activities of Department of Defense Laboratories through summer science and engineering research experiences.
- Provide students with opportunities in and exposure to scientific and engineering practice and personnel not available in their school environment.
- Prepare these students to serve as positive role models for their peers by encouraging other high school students to take more science and math courses.

SEAP Locations:

ANSER, Arlington, VA; ARL-A, Adelphi, MD; ARL-CISD, APG, MD; ARL-SEDD, Adelphi, MD; ARL-SLAD, APG, MD; ARL-WMRD, APG, MD; CERDEC, Ft. Monmouth, NJ; GARRED, Redstone Arsenal, AL; MRICD, APG, MD; NATICK, Natick, MA; NHRC/EHEL, Wright Patterson





AFB, OH; NASA, Fairmont, WV; RDECOM, APG, APG, MD; RDECOM-IL, IL; WRAIR, Silver Spring, MD

CQL is a program for college students who may or may not have previously participated as high students in the SEAP program. Accomplished undergraduate and graduate interns may complete daily research tasks, perform data analysis and contribute to research and publications.

Near-peer mentors are CQLs who divide their time between the teaching laboratory and the research laboratory. As a near-peer mentor, they prepare and teach modules, often related to their specific laboratory skills and knowledge, to the GEMS students.

Goals:

- Afford SEAP mentors the opportunity to have fully trained students return to their laboratory during their college years.
- Mentors have the opportunity to share their passion for science with talented undergraduates.
- Give SEAP students the opportunity to continue their research and training.
- Undergraduates and graduates learn the research process by doing actual studies.
- Provide a learning community for the developing professional
- Prepare a new generation of scientists to be mentors.



GEMS Near-peer mentors 2006 (CQL)

Psyched on science

Publish Date: 07/27/06

By Alison Walker-Baird

News-Post Staff

FREDERICK — Eleven-year-old Victoria Elliott grinned from under blue-rimmed laboratory goggles. Sitting in a West Frederick Middle School classroom Wednesday, she and other middle school students prepared clear gels used to study DNA by a process called electrophoresis.

Later in the afternoon, the students would use what they learned, and what most have seen on TV shows such as "CSI," to solve a fictitious crime. The activity was one of many in Fort Detrick's Gains in the Education of Mathematics and Science program, or GEMS, designed to foster middle-schoolers' interest in these fields.

"Every kid should have the privilege to come to a program like this," Victoria said, sitting at the laboratory table with five other students, all wearing white lab coats.

Fort Detrick created the program this year to get students interested in mathematics and science at an early age and encourage them to take the necessary preparation courses, said Edward Nolan, who directs Fort Detrick's Community Support Programs. Encouraging more young people to go into these fields means "building the bench"—replacing retiring scientists with new ones, he said.



Staff photo by Doug Koontz

Rashan Tipon works on a drawing of a bacterial culture grown from samples taken around the classroom as part of Fort Detrick's Gains in the Education of Mathematics and Science program.

The four-week program hosts 135 sixth-, seventh- and eighth-graders who were divided into four groups. Each group spends one week, Monday through Thursday, at West Frederick Middle. GEMS began July 10 and will end Aug. 3.

The program is open to students at West Frederick and children of Fort Detrick employees. Maggie Gilgallon, a teacher at West Frederick, said the majority of participants are students at the middle school.

Mr. Nolan said the program may be opened in future years to all Frederick County students.

High school seniors and undergraduate students lead the middle-schoolers in hands-on activities. Near-peer mentors probably have more of an effect on the young students than older instructors, Mr. Nolan said.

Chrissy Harvey, a Hood College senior majoring in biology, led Victoria's group in preparing the gels, which the students planned to use to identify the murderer in their afternoon activity.

"A lot of people see science as a challenge," Ms. Harvey said. "We want to show that yes, it's a challenge, but it's fun, and they can learn great things along the way."

The mentors prepared for GEMS by creating instructor's manuals and tailoring the lessons to make them interesting to middle-schoolers, said Elizabeth Leffel, a scientist at the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID)at Fort Detrick.

Ms. Leffel designed the program's curriculum with John Carra of USAMRIID and John Ezzell, a former USAMRIID scientist. She said Paulette Shockey, the middle school's principal, encouraged the scientists to focus on areas the school's curriculum doesn't address.

GEMS is modeled after a program for high-schoolers led by the Walter Reed Army Institute of Research in Silver Spring, Ms. Leffel said.

Hands-on experiences and exciting activities help create an appreciation for science a textbook might not, Mr. Ezzell said.

"So far, we've had a favorable response from the kids," he said. "They see science is anything but boring."

Earlier in the week, the students made a wave machine, which uses string to replicate sounds waves, that they could keep.

Monday, the GEMS participants took samples of areas in the room and grew the collected bacteria on plates containing a nutrient-rich gel, or agar. The groups recorded the resulting bacterial growth's texture, size, shape and its number of colonies Wednesday.

"The word 'scientific' comes from 'scientia,' which is Latin for knowledge," Mr. Ezzell said. "They're gaining knowledge about the world around them."

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